POWER

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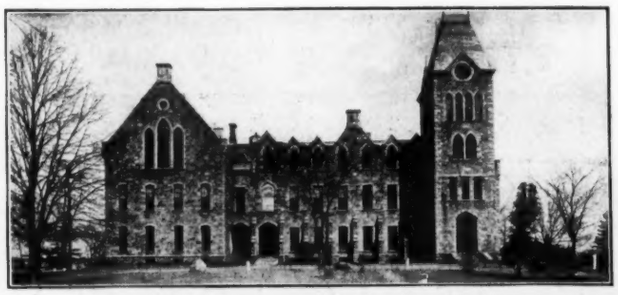
THESE indicator diagrams tell three separate and distinct stories graphically. Road No. 1 shows how an engineer may be "raised." Road No. 2 shows how he may be content to keep things going as they are without improving anything. Road No. 3 shows how the same diagram with which the other two engineers started goes from bad to worse. The discharge of the engineer is inevitable.

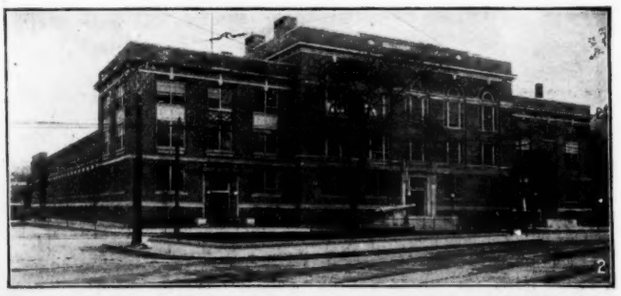
The engineer who came out "on top" first improved the card, making it as perfect as he could under existing pressure conditions. Later, he increased the steam pressure and reset the valves to make full use of compression, expansion, and the higher efficiency of greater temperature variation.

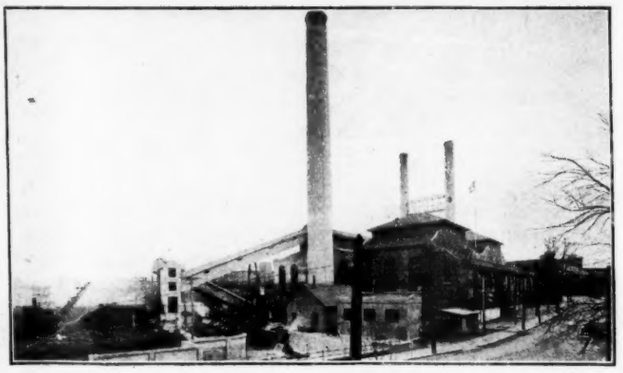
The engineer who was "retained" did not realize that improvement was possible. He had an indicator of his own and carefully took cards periodically. As long as the shape of the card remained the same and as long as the engine pulled full load without knocking, the "retained" engineer was satisfied.

The engineer (?) who traveled Road No. 3 did not believe in indicators. He believed in setting an engine valve by "sound." The engine knocked badly, of course, but the "engineer" knocked things in general even worse. In his case the "boss" or "somebody else" was always to blame.

Meeting of the American Society of Mechanical





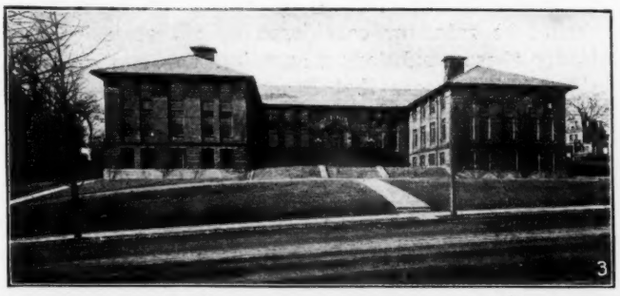


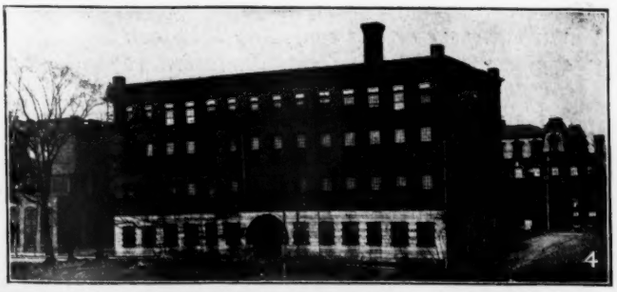
PERSONS AND PLACES OF INTEREST TO THOSE ATTENDING THE SPRING

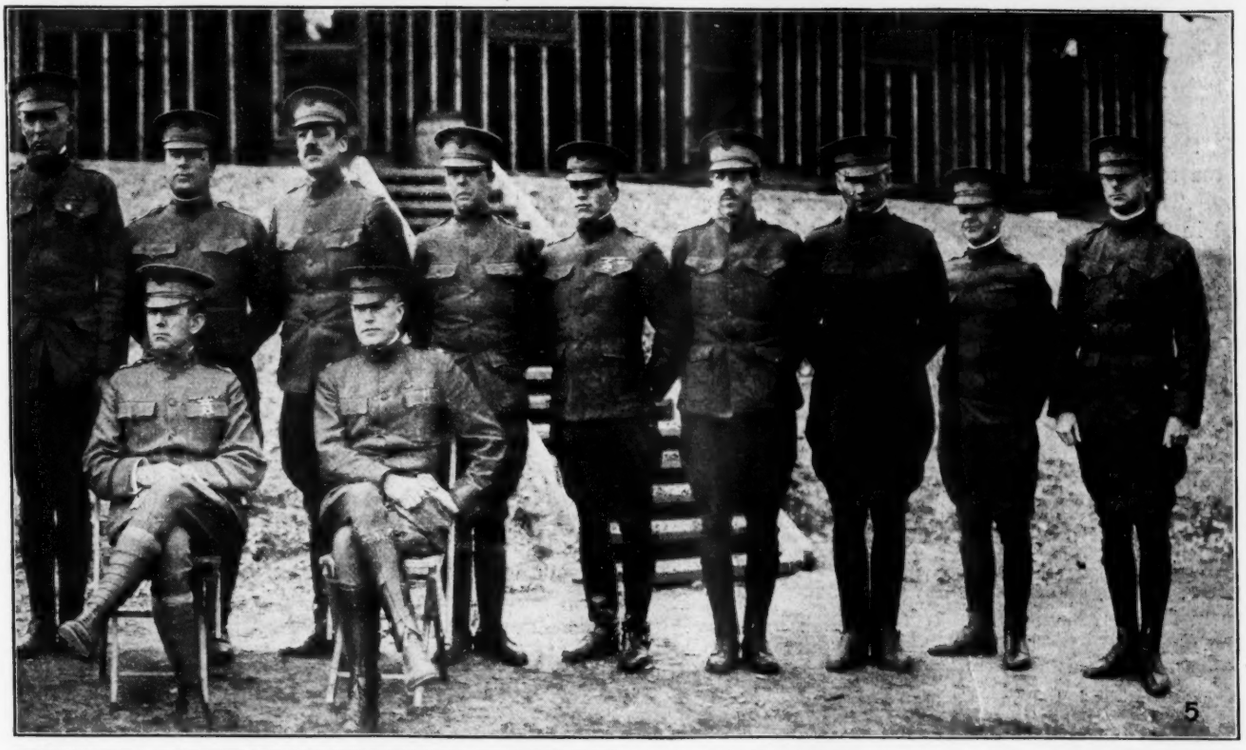
Fig. 1—Boynton Hall (Administration), Polytechnic Institute; sessions will be held here. Fig. 2—Worcester Trade School. Fig. 5—Major General Hodges (third officer seated) and Staff, Camp Deven, Ayer, Mass.; the camp will be visited Fig. 8. New Boiler House, The Norton Co. Fig. 9—General View of Part of the

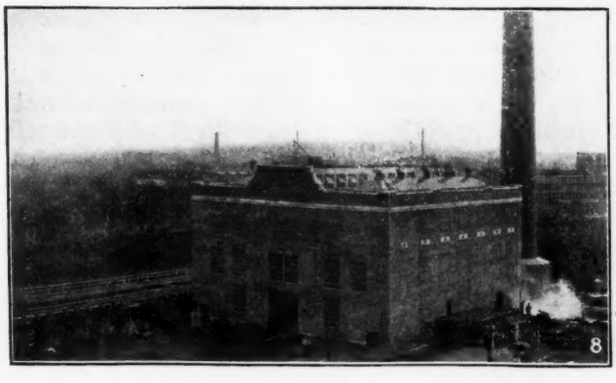
WORCESTER is the home of two past presidents of the society, namely, Charles H. Morgan and Dr. Ira N. Hollis. The city owes its place as a manufacturing center to the several buildings where power was furnished to tenants who eventually built factories for themselves in the city as their business grew. Some of these old buildings are still standing, and from one of them the other day an old Corliss engine, built in 1852, was removed. The Worcester Polytechnic Institute was started with the assistance of John Boynton, who made his money as a peddler and who contributed liberally to the fund that built old Boynton Hall. The lock system of the Panama Canal is said to be patterned after the locks in connection

Engineers, Worcester, Mass., June 4, 5, 6 and 7









MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Fig. 3—Electrical Laboratory, Worcester Polytechnic Institute. Fig. 4—Mechanical Engineering Laboratory, Polytechnic Institute. Fig. 6—Bancroft Hotel where those attending will register. Fig. 7—New Plant, Worcester Electric Light Co. Works of the Norton Co. which will be visited by those attending.

with Clinton Dam, near Worcester, which those attending the meeting will visit. Worcester has high- and low-pressure water systems, both of the gravity type; high-pressure, 150 lb., low pressure 85 lb. Camp Deven is but twenty-six miles from Worcester and is one of the large army cantonments. Worcester's population is 200,000, and 3,000,000 people are within fifty miles.

The Fuel Session, scheduled for Thursday, June 6, promises to be a most interesting one; it was arranged for by the Fuel Conservation Committee of the Engineering Council. A. A. Potter, Dean of the Engineering Schools, University of Kansas, will read a paper on "An Investigation of the Fuel Problem in the

(*Continued on page 762*)

Figuring Furnace-Grate Area

Various more or less confusing ideas are held by engineers and stoker manufacturers regarding the figuring of grate area. Every manufacturer has some rule based upon his experience with his particular equipment. This article sets forth the rules followed by a number of manufacturers as to what is considered active grate and as to whether actual or projected grate area is used in figuring the grate area of their stokers.

IF A boiler containing 5000 sq.ft. of heating surface were to be installed, how much grate area would you put in the furnace and how would the grate area of the various types of stokers manufactured be figured? In the general run of power plants the ratio of grate area to the boiler-heating surface averages about 1 to 56. This ratio is as low as 1 to 48 and as high as 1 to 69 in individual cases. One power plant now in operation is so overstokered that the ratio is about 1 to 27. From the prevailing custom it would appear that a boiler plant is designed for so many square feet of heating surface per boiler horsepower (usually 10 sq.ft.) and that the grate area is put in, not in accordance with any standard usage, but to conform to whatever ratio the designer may favor.

However, assuming that one square foot of grate area is allowed for each 50 sq.ft. of boiler-heating surface, how is the area of the grate to be figured?

The view of one stoker manufacturer is that most of them seem to hold to some rule based upon their experience with their particular equipment, and it would seem that for any particular make of stoker whatever the manufacturer considers as grate surface should be considered as the grate area of the stoker in engineering problems. The manufacturer's rules for stoker area apply to the amount of coal that can be burned per

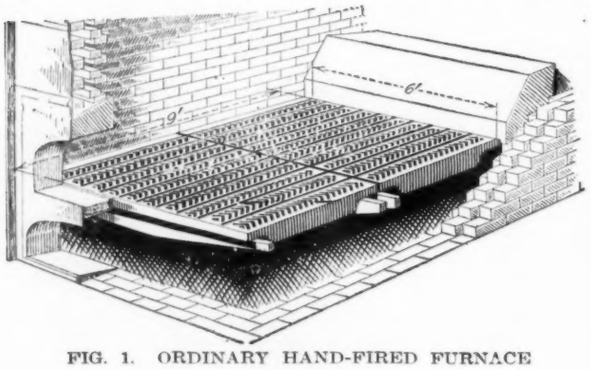


FIG. 1. ORDINARY HAND-FIRED FURNACE

square foot of grate surface per hour with varying conditions of draft, and these rates of burning are commonly used in proportioning a stoker for the load conditions to be met.

Taking the double inclined type of stoker, if the manufacturer makes a practice of estimating 30 lb. of coal per square foot of projected area of the grate surface, and assuming that the data on this basis are the most reliable source of information that can be obtained, therefore on figuring up stoker sizes where the manufacturer's datum of 30 lb. of coal is used, the stoker should be rated or considered on its projected area. Under these conditions where but one stoker is considered, it appears that it makes no great difference what is considered as grate area so long as the same area is used as when computing the pounds of coal burned per square foot of grate surface per hour.

Another feature of the question of grate surface is the comparison of, say, 100 sq.ft. of, say, a single inclined gravity fuel stoker with, for instance, 100 sq.ft. of chain-grate area. There would be an extreme difference in the nature of the fuel bed of the two stokers and in the difference in air spaces, and for these reasons there cannot be any just comparison as to the performance of a square foot of grate surface per hour of one of these stokers with a square foot of the other type. One

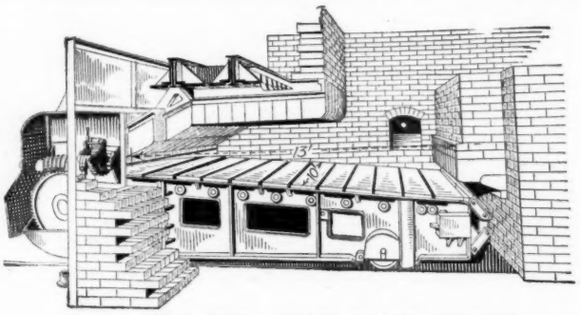


FIG. 2. INCLINED CHAIN-GRATE STOKER

chain-grate stoker manufacturer states that under similar conditions his stoker can burn twice as much bituminous coal per square foot of area as can be burned with either a single or double inclined stoker, and this regardless of how the grate area is computed.

This statement emphasizes what has been said—that the important thing is the performance that can be secured with a unit of grate area. This is emphasized by a consideration of the underfeed stoker which is rated on the performance of the retorts of specified dimensions.

Figuring the grate area of a chain-grate stoker is the same as calculating that for an ordinary horizontal hand-fired grate; that is, the width times the length, as shown in Fig. 1, the width of the grate being 6 ft. and the length 9 ft. The grate area would therefore be $6 \times 9 = 54$ sq.ft. Although the dead-plate is within the furnace walls, it is not figured as grate area.

In the case of the chain-grate stoker the normal length of the grate is figured, the normal length being the distance from the inside of the stoker feed gate to the front side of the bridge-wall or water-box when so equipped, or to the flexible bridge-wall of other design. The normal length of the grate times the width between the furnace walls at the fire line equals the grate area. Thus if the grate is 13 ft. long between the feed gate and the water-back and the width of the grate is 10 ft., the grate area would be $10 \times 13 = 130$ sq.ft. Some chain-grate stokers are placed level and others are on an incline, as shown in Fig. 2, the pitch being approximately $\frac{3}{4}$ in. to the foot. Thus a grate 10 ft. long would be 7.5 in. lower at the rear end than at the front. The difference in length due to the inclined grate over

one set level is so small that no difference is made in calculating the area.

The type of stoker having both flat and inclined surfaces presents another phase in area calculation. Both are figured as active grate area, the actual area being considered. For instance, in Fig. 3, assume that the flat grate is 4 x 6 ft. and each of the inclined is 2 x 6 ft., then the total area of the grates would be $(4 \times 6) + (6 \times 2 \times 2) = 48$ sq.ft. This method of figuring is in accordance with the assumption that active grate area, whether flat or inclined, is that part that is provided with air available for burning fuel.

Considering the front inclined type of stoker, Fig. 4, the total grate surface with the approximate dimensions is 8 x 10 ft. This is all grate surface between the front wall and the vertical portion of the bridge-wall including the dump plate. The effective grate surface includes the full width of the grate, which is 8 ft., and the distance from the top grate bar to the bottom grate bar measured on the inclined plane or the length 9 ft. or $8 \times 9 = 72$ sq.ft. In the type of stoker shown the

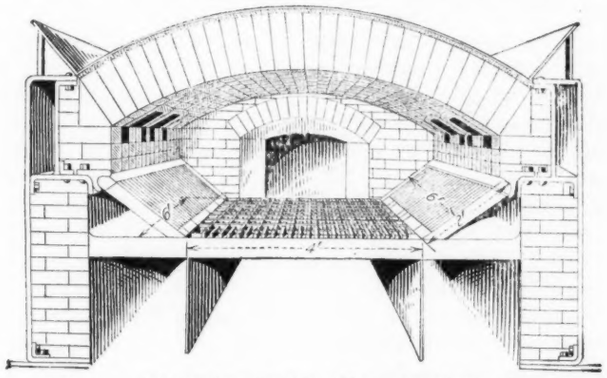


FIG. 3. COMBINED FLAT AND INCLINED GRATE

area of the dump plate is not considered as effective grate surface, which is as it should be.

One would suppose that the method of figuring a front gravity-feed stoker would be the same as with a gravity side feed. However, the substance of what a manufacturer of the latter type says is to the effect that in stating the grate surface either the projected or the actual grate surface is specified. To figure the former the actual flat area is taken the same as with a flat grate. In figuring the actual area the length of the grate from the feed opening to the lower end of the grate is taken and this is multiplied by the depth of the furnace. This company uses one method about as frequently as the other. In drawing up specifications engineers usually specify either actual or projected area and the manufacturers specify accordingly. The actual area is approximately 25 per cent. greater in the side gravity-feed stoker than the projected area. Fig. 5 shows the type of stoker and the difference between the method of calculating the area. With the figures given the projected area would be $11.5 \times 10 = 115$ sq.ft. and the actual area would be $10 \times 7 \times 2 = 140$ sq.ft., a difference of 25 sq.ft., or 22 per cent. greater actual than the projected area. The clinker-grinding portion of the stoker should not be included in the actual grate area.

In considering the underfeed stoker, Fig. 6, a difference of opinion seems to exist. One type makes use of dump plates, and these are included as projected area which is used in figuring this type of grate, as the slant of the grates at either side of the feeding trough is but slight.

A similar type of stoker does not take into consideration the grate area of the furnace as related to the coal-burning capacity. Each underfeed stoker is usually fig-

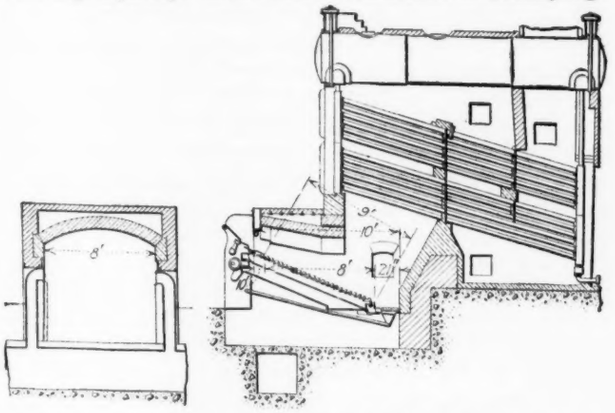


FIG. 4. FRONT GRAVITY-FEED INCLINED STOKER

ured on the coal-burning capacity of the retort and the tuyere area, and this has nothing to do with the grate area. Furnace width, however, is taken into consideration in connection with the kind of coal burned, as if the fuel is high in refuse a greater furnace width is desired. The coal-burning capacity of an underfeed-stoker retort is dependent upon the quality of the coal and the percentage of refuse. The relation of fixed carbon and volatile matter is also important. In underfeed stokers, combustion is due to the tuyere area itself and not to any auxiliary grate area or to any combustion that may take place on any dumping plates. The underfeed principle involves the distillation of the gases at the point below the incandescent bed of fire and not on top of the grates or dump plates. Where these are resorted to increase the coal-burning capacity, the stoker system be-

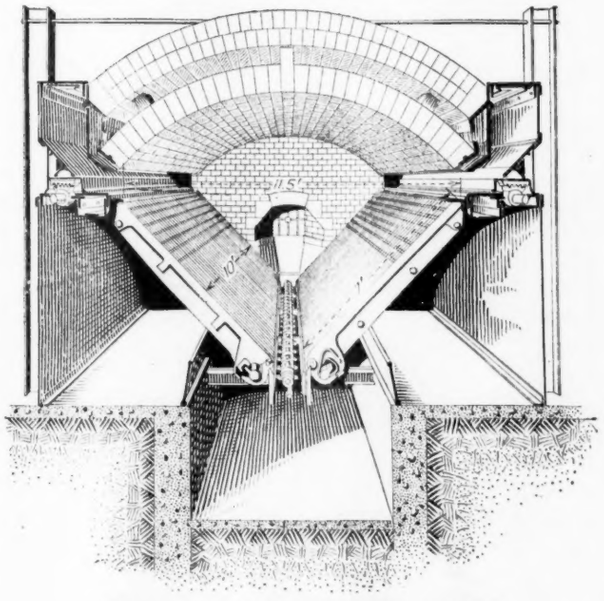


FIG. 5. SIDE GRAVITY-FEED STOKER

comes a combination of underfeeding and overfeeding as the combustion on the grates and dump plates is the same as on any other system of overfeed fires.

An inclination of the tuyere line does not affect the

coal-burning capacity, and therefore there is nothing but the actual area of the air space of the tuyere to be taken into consideration. When using an underfeed stoker, any lack of furnace area due to a narrow furnace can be compensated for by securing increased room for combustion by elevating the boilers. From this it is evident that the area has nothing to do with the coal-burning capacity of an underfeed stoker.

Considering the front-feed inclined type of underfeed stoker, Fig. 7, the part of the stoker that supports the fuel and delivers air under pressure for the burning of coal should be considered as grate area; and as has already been stated, grate surface is a somewhat meaningless term and one that is misleading when used in connection with this type of stoker.

One manufacturer states that ordinarily when specifying grate area, it refers to the projected area of the stoker on a horizontal plane and includes the entire area bounded by the brick walls. Of course every portion of this area is available for the burning of some combustible. However, in his own practice for the purpose of design quite a different area is used. For instance, an imaginary line is established above the air openings which it is assumed represents the surface that is reached by the air discharged from the tuyeres and grate openings. This line establishes an imaginary active grate surface, and the projected area of this grate surface is what is termed active grate surface.

Grate surface actually means but little, as the important factor is the admission and distribution of air, and the method of determining grate area as outlined in the foregoing seems to be fairly consistent in so far as the type of stoker with which it is used goes. The imaginary surface is approximately 13 in. from the air openings and on a line with them and makes each retort of the stoker practically 13¾ sq.ft. projected area.

One builder of this type of stoker uses a double-leaf dump, of which there are two types. In one design the

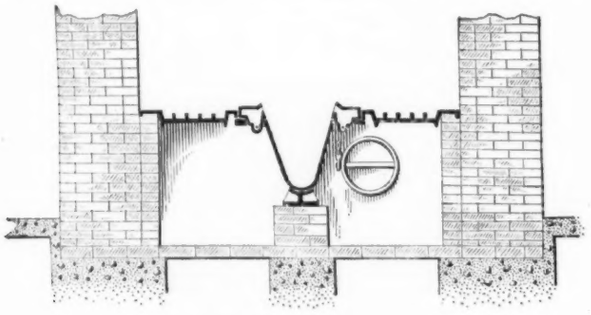


FIG. 6. ONE TYPE OF UNDERFEED STOKER

rear leaf of the dump is not supplied with air under pressure, and the grate area should stop at the end of the forward dump; the rear dump is not considered as grate surface. The other type has a rear dump designed to supply air under pressure from a main air duct, and since this dump can be covered with fuel, the manufacturers consider it active grate surface. Where crushing rolls are used for removing ash from the furnace, they should not be included as active grate surface.

One manufacturer, when making a statement as to the grate area of the front gravity fuel underfeed stoker, always specifies whether the projected or the actual area is given because there is no standard method of determining the grate surface and the figures may be misleading unless it is specified whether actual projected area is being considered.

Another manufacturer of the last type of stoker under consideration holds views contrary to the other, as regards considering the dump plate as grate area. In this instance the usual practice in figuring the square feet of grate surface is to use the projected area of the stoker including the dump, as it is claimed that the com-

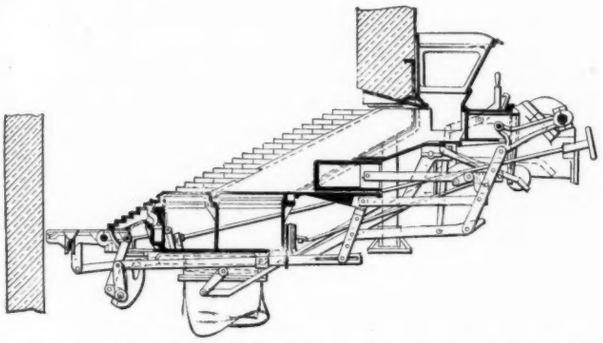


FIG. 7. FRONT-FEED INCLINED UNDERFEED STOKER

bustion actually takes place from the front wall clear back to the bridge-wall. The reason for including the dump as grate area is because the path of least resistance for the air through the fuel bed is generally toward the bridge-wall, and even if there is no definite air supply at the rear end of the stoker, there is still ample air coming through from the fuel bed above to maintain active combustion. For this reason the makers of this stoker claim that it is legitimate to include the dump as grate area when figuring the grate surface of the underfeed stoker.

In considering the underfeed type of stoker, the volume of coal in the retort below the end of the tuyeres, the throat under the front of the plungers and the total volume of coal, which includes that in the retorts, and the thickness of the fire over the surface of the stoker, are of importance. The fuel total volume thickness averages about 1 ft., an average ranging from 18 to 24 in. at the thickest part of the fuel bed to 6 or 8 in. at the lower end and dump plate. The most satisfactory comparison of an underfeed stoker is to get the ratio between the retort volume and the total volume, or between the retort volume and the grate surface.

Boiler Capacity Depends

The active heating surface in a boiler will evaporate from 3 to 6 lb. of water from and at 212 deg. F. per square foot per hour, and 34.5 lb. of water per hour "from and at" is the standard rate of evaporation per boiler horsepower; therefore anywhere from 5½ to 12 sq.ft. of heating surface is required per boiler horsepower. This great variation in evaporative capacity is not necessarily inherent in type, design or installation. A boiler capable of the best performance may under unfavorable conditions be doing no better than the poorest. Neglect of the heating surface, inside and outside, is one of the most frequent causes of reduction in capacity.

The dollar that you contribute to the Red Cross Fund may save the life of one of our boys in France.

"Resisto" Furnace Paint and Putty

One of the certainties of boiler-room practice is that the fire-brick lining of the furnace will burn out sooner or later, depending upon the intensity of the fire. Renewing the lining is expensive, to say nothing of the loss of the boiler while the work is being done. The need for a furnace material that will withstand the high temperatures now maintained is well known, and

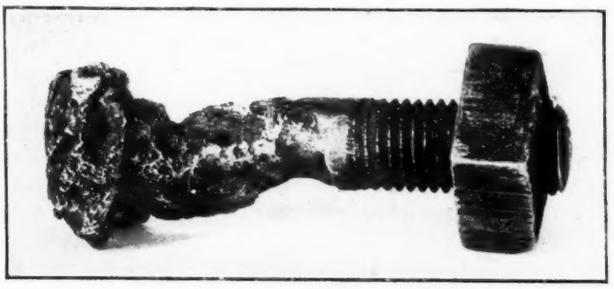


FIG. 1. PART OF BOLT NOT COVERED WITH THE PUTTY FUSED AND BURNED

although there has been a great advancement in the construction of such material, there still remains much to be desired.

Although there are several fire-resisting compounds on the market, one known as Dunbar's "Resisto," and manufactured by Wm. Clifford & Sons Co., 358 Union Ave., Elizabeth, N. J., seems to have the necessary qualifications for protecting firebrick, fire tile and iron from the effect of high temperatures. This fire-resisting compound comes in the form of a paint and a putty, and when used on furnace brick requires no drying out before starting the fires after the application.

Not only can this material be used for laying up new furnace brickwork in which ordinary fireclay is com-

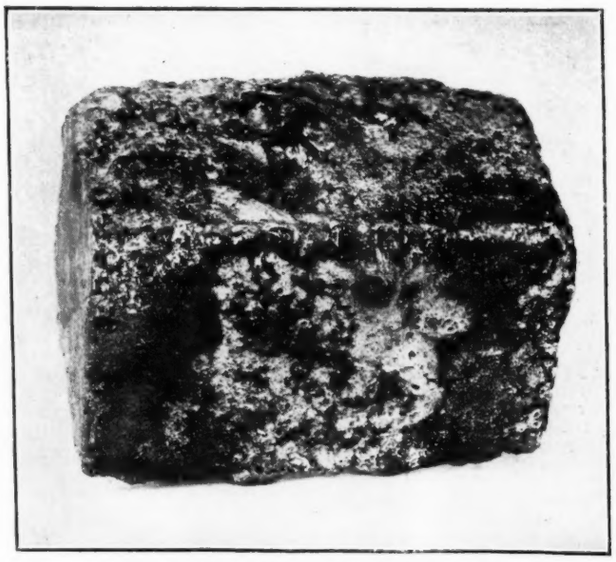


FIG. 2. BRICK THAT HAS BEEN PAINTED AND EXPOSED TO HIGH TEMPERATURE

monly used, but the putty is adaptable for pointing up old brickwork and for covering such metal as might be exposed to the furnace heat.

In laying up new firebrick, they can be either dipped in the material or "buttered" in the usual manner. It is necessary, however, that they be clean, dry and free from grease or oil. After the work has been completed, it is coated with the paint and the furnace is then ready for use. When the brickwork is exposed to exceptionally high temperature, two coats of paint are advisable. When pointing up old brickwork the old joints must be cleaned out not less than one-half inch, given a coat of paint and then filled with enough putty to make a smooth surface.

Some idea of the heat-resisting properties of this compound and paint can be gathered from the illustrations. In Fig. 1 is shown what is left of a common wrought-iron bolt. The nut and threads were covered with a ¾-in. thickness of putty and the whole put in a blacksmith's forge and brought to a white heat. The part of the bolt not covered was fused and burned as shown. As the melting point of wrought iron is about 2550 deg. F., it shows that the bolt was subjected to a

FIG. 3. BALL OF PUTTY AFTER BEING IN TEST FURNACE

greater heat than obtains in the average boiler furnace under average conditions.

The action of the paint may be seen in Fig. 2, which shows a piece of brick taken from a furnace bridge-wall after four days' exposure to a temperature of about 2500 deg. F. The brick was given a coat of "Resisto" paint, which, when subjected to heat, vitrifies and forms a glazed surface, as shown by its slag-like appearance. Although the brick is in two pieces, the joints cannot be easily distinguished, thus showing that the furnace brickwork joints are protected against rapid deterioration.

Another example of the heat-resisting properties of "Resisto" is shown in Fig. 3, which is a photograph of a 2-in. diameter ball of putty that has been subjected to about 3000 deg. temperature in a test furnace. The test had to be discontinued before any effects detrimental to the putty could be noticed, as the furnace began to melt.

It would appear that where this material is used for furnace construction, it will strengthen the brickwork considerably, which, together with its heat-resisting properties, should obviate the necessity of rebuilding the furnace brickwork at such frequent intervals as has been the common practice.

Boiler Settings*

By CHARLES H. BROMLEY
Associate Editor of "Power"

One of a number of articles on boiler settings for various stokers under the many different boilers adapted to high-volatile coals.

IT WOULD be well, at the beginning of these articles, to broadly consider boiler settings or, better, combustion volume, that one's perspective may be broadened, if need be. So much has been written on this subject that most engineers are convinced of the need of large combustion volume. But these articles are intended primarily to convince those who are not convinced, either because they are unfamiliar with the subject or because they are plainly obstinate. There are more of these people than most of us have allowed ourselves to believe there are. The secondary purpose is to present the most modern practice of setting boilers as related to improving combustion.

At least until very recently no really scientific thought was given to the relationship that should exist between combustion volume, kind of coal, combustion rate and excess air. In fact, few gave but the most superficial consideration to the subject. An example of this is illuminating: Within the month the writer asked two engineers what combustion volume per square foot of active grate surface they allowed in their boilers, volatile content of coal considered. One of these engineers is distinguished for his boiler work; the other has conspicuously contributed to power-station design and operation. The former did not know; the latter had "never looked at it that way." He sets his boilers as high as he can and lets it go at that. Obviously, this is working in the dark. Contrast this unscientific method with the elaborate research made to develop greatest efficiencies in turbine nozzles and ship propellers. Yet in the boiler the action is, for the most part, chemical and highly complex, while in both of the other cases it is mechanical. The first scientific attempt to determine the most suitable ratios of combustion

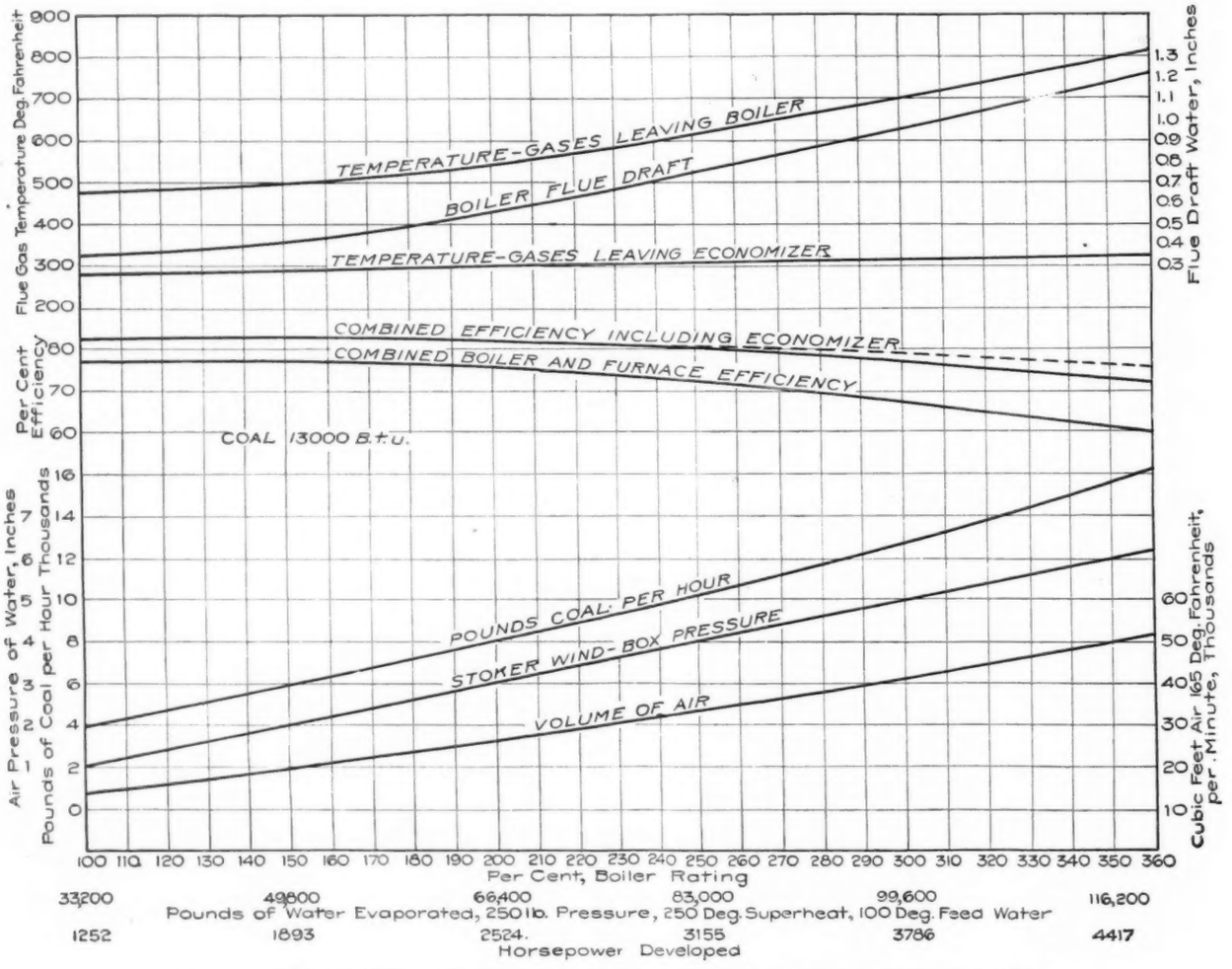

Flue Gas Temperature Deg. Fahrenheit
Flue Draft Water, Inches
TEMPERATURE-GASES LEAVING BOILER
BOILER FLUE DRAFT
TEMPERATURE-GASES LEAVING ECONOMIZER
Per Cent Efficiency
COMBINED EFFICIENCY INCLUDING ECONOMIZER
COMBINED BOILER AND FURNACE EFFICIENCY
COAL 13000 B.t.u.
Air Pressure of Water, Inches
Pounds of Coal per Hour Thousands
POUNDS COAL PER HOUR
STOKER WIND-BOX PRESSURE
VOLUME OF AIR
Cubic Feet Air 165 Deg. Fahrenheit, per Minute, Thousands
Per Cent, Boiler Rating
Pounds of Water Evaporated, 250 lb. Pressure, 250 Deg. Superheat, 100 Deg. Feed Water
Horsepower Developed

FIG. 1. PERFORMANCE CURVES, 14-RETORT UNDERFEED (WESTINGHOUSE) STOKER

*For previous articles of this series see the following issues of "Power": "Zone System for the Distribution of Bituminous Coal," May 14, 1918. "Coals of the United States," May 21, 1918.

volume and combustion rate for particular coals that I know of were the experiments by Kreisinger, Augustine and Ovitz for the Bureau of Mines, reported in Bulletin No. 135, recently distributed. [This bulletin

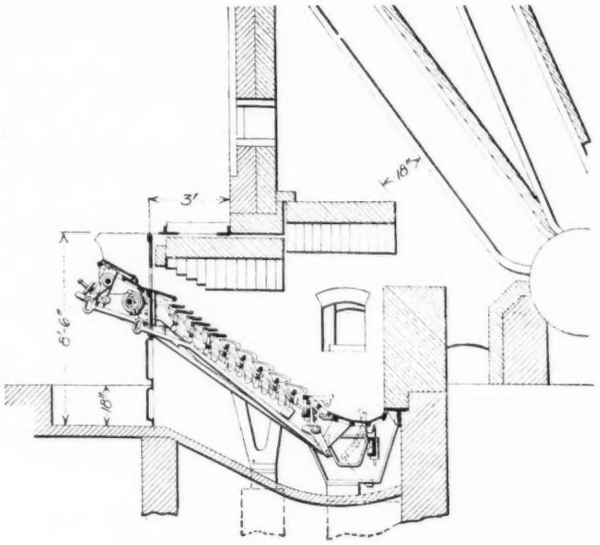


FIG. 2. SECONDARY ARCH ASSISTS IN MIXING AIR AND COMBUSTIBLE GASES

was reviewed by the writer in *Power* for Apr. 23, 1918.] E. H. Peabody, in that excellent paper, "Oil Fuel," presented before the International Engineering Congress, San Francisco, September, 1915, has three interesting paragraphs on the subject of furnace volume and combustion rate, on pages 103 and 104. But as to ratios or their equivalents, he merely points out that some relation exists between the heat liberated and the combustion volume, but is not specific as to these ratios.

Tables I and II are from Bureau of Mines Bulletin 135; both are unusually interesting in combustion-volume studies.

TABLE I. CHEMICAL CHARACTERISTICS OF THREE COALS TESTED

	Pocahontas Coal	Pittsburgh Coal	Illinois Coal
1. Volatile matter in moisture and ash-free coal, per cent	18.05	34.77	46.52
2. Fixed carbon in moisture and ash-free coal, per cent	81.95	65.23	53.48
3. Carbon in moisture and ash-free coal, per cent	90.50	85.7	79.7
4. Volatile carbon in moisture and ash-free coal, per cent	8.55	20.47	26.22
5 Available hydrogen in moisture and ash-free coal, per cent	3.96	4.70	3.96
6 Ratio of volatile carbon to available hydrogen, per cent	2.16	4.35	6.6
7. Oxygen in moisture and ash-free coal, per cent	3.32	5.59	10.93
8. Nitrogen in moisture and ash-free coal, per cent	1.19	1.73	1.70
9. Moisture accompanying 100 per cent. of moisture and ash-free coal, per cent	2.53	2.88	22.07
10. Volatile matter times ratio of volatile carbon to available hydrogen (product of items 1 and 6)	39.00	151.00	307.00
11. Ratio of oxygen to total carbon, in moisture and ash-free coal	0.0367	0.0652	0.137
12 Total moisture in furnace per lb. of coal reduced to moisture and ash-free basis, lb	0.409	0.501	0.70

That furnace volume alone will not necessarily give the most efficient combustion commercially is widely known. Complete mixture of air with the combustible gases is the all-important factor. This is shown by Bone's surface-combustion experiments; it is shown in the gas engine, and to a lesser degree in the underfeed stoker with its thick fuel bed. Above a limit of temperature, say 1200 to 1800 deg. F., mixture of air and combustible gases exerts a far greater influence upon the efficiency of combustion than temperature and furnace volume. In fact, furnace volume is merely an expedient to insure good mixture by lengthening the time of contact of gases and air.

If immediately above the fuel bed of an underfeed stoker there were placed a zone of high heat-resisting refractory material, broken in pieces and not so dense as to offer objectionable resistance to gas flow and

TABLE II. COMBUSTION SPACE REQUIRED FOR POCAHONTAS, PITTSBURGH AND ILLINOIS COALS

Completeness of Combustion, per Cent. Undeveloped Heat	Rate of Combustion Lb. per Sq. Ft. of Grate per Hour	Excess of Air, per Cent.	—Cubic Feet of Combustion Space per Sq.Ft. Grate— Pocahontas	Pittsburgh	Illinois
1	2	3	4	5	6
5	50	50	2.7	2.9	4.3
3	50	50	3.2	3.7	5.3
2	50	50	3.6	4.4	6.3
1	50	50	4.0	5.6	8.9
0.5	50	50	4.8	6.8	11.9
5	25	50	2.0	2.2	3.5
3	25	50	2.3	2.7	4.35
2	25	50	2.7	3.1	5.1
1	25	50	3.4	4.0	6.2
0.5	25	50	4.0	5.0	7.1

protected against too rapid burning away by means of resting on water tubes integral with the boiler—in other words, using the stoker as a gas producer and passing the gas through an incandescent zone—it would likely be found that furnace volume could be materially decreased below present requirements with high-volatile coal and high combustion rates. Provision for further air admission and distribution between the fuel bed and refractory zone would of course be neces-

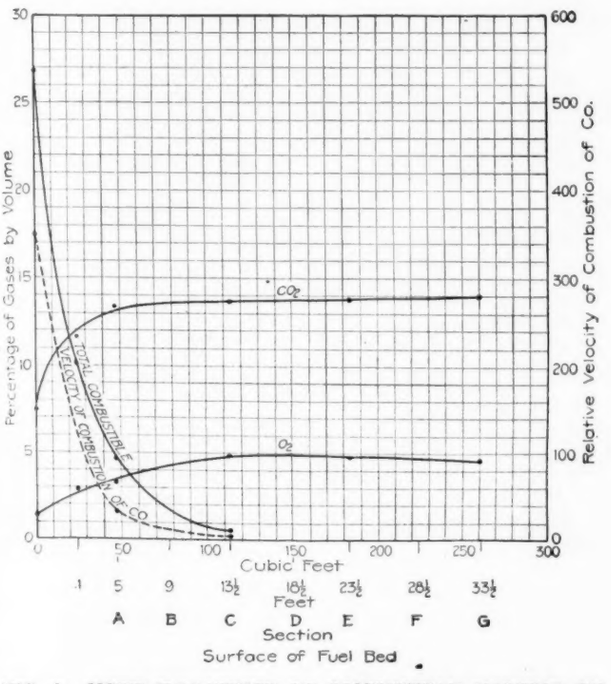


FIG. 3. NOTE INFLUENCE OF COMBUSTION VOLUME ON COMPLETENESS OF COMBUSTION

sary; but it would be merely the presence of air that would be necessary, the broken refractory zone would insure good mixing because of the character of its porosity—and this zone would of course be very hot.

Most of us have regarded heat as the all-essential factor in combustion. Even now, unless we stop to check our thought, we regard the sole function of furnace arches as heat-radiating or reflecting surfaces.

We likely will soon universally see that except for short coking arches, the really important thing they do is to roll or scrub the gases and air and promote an intimate mixture of them *in the presence of high temperature.*

There is no question that this is the fact. Everyday boiler-room experience confirms it. Why is it that the underfeed stoker gets its efficient performance with no arches at all? Because the character of the fuel bed and air-admission areas insures a thorough mixing of air and gases within the fuel bed and in the presence of high temperature. With no arches whatever, an underfeed stoker will give an almost flat combined boiler-efficiency curve between 100 and 300 per cent. rating, and with economizers one can say, without being charitable, that it is flat. See Fig. 1.

Secondary Arches Sometimes Superfluous

Secondary arches are usually at a considerable height above the fuel bed. Here they merely reflect heat and do not contribute appreciably to mixing the air and gases. They are sometimes superfluous, and when far removed from the fire in an ordinary boiler setting, are probably wholly superfluous. This is borne out by the gradual abandonment of the secondary arches on Stirling boilers of the usual class. Here the secondary arch is far from the fire and cannot exert an appreciable influence upon the fuel bed because of its distance from it, and does no good whatever in coking the coal, unless the grate is run too fast, because of the curtain wall between the coking and secondary arches.

That we too generally overlook the mixing function of arches is brought out by a statement to me by Mr. Stowe of the Laclede-Christy Clay Products Co., who, in discussing secondary arches in Stirling boilers, says that they have had no little difficulty in getting away from the secondary arch, customers insisting on their use until made thoroughly familiar with performance without them. And yet we chide marine engineers because they are slaves to precedent and custom!

A secondary arch may, however, in some settings, be useful for mixing the air and gases, provided the bridge-wall is continued high enough to form a narrow passage between the end of the bridge, wall and the end of the secondary arch, as in Fig. 2.

Chicago Hand-Fired Furnaces

The excellent work of the Chicago Smoke Inspection Department under Monnett gave a memorable impetus to intelligent combustion under boilers. Though Monnett, Vial and Misostow, all of the Chicago department, did not aim to determine what ratios of furnace volumes and combustion rates were most suitable, they early found that smokelessness and economy were greatly improved by their attempts to obtain intimate mixture of air and gases in a high-temperature zone. Witness the hand-fired boiler settings developed while Monnett was chief of the Chicago Smoke Department. In all of these the chief function of the arches is that of mixing air and gases.

The curves, Fig. 3, show the effect of furnace volume upon efficiency of combustion. They are from Bureau of Mines Bulletin 135, already referred to. The stoker used was the Murphy set in a special furnace of 5 ft. square section beyond the stoker and 43 ft. 4 in. long. The coal burned was Pittsburgh screenings, and the combustion rate was 35.6 lb. coal per hour. Notice that at 13½ ft., average length of travel from the surface of the fuel bed, there is little combustible gas left. The usual boiler settings do not begin to approach the ideal as nearly as this one, and the combustion rates at peak loads are usually much higher than in these tests. In modern boiler settings for underfeed stokers, the space directly above the fuel bed is about 10 ft. wide and a mean of about 8 ft., for a 500-hp. B. & W. type boiler set with the bottom of the front header 12 ft. from the floor. The space is clear, unobstructed, with no wing walls, arches or other objects to give a rolling, mixing or scrubbing action to air and gases. It is likely that the results for the same length of gas travel at the same combustion rate would be much less favorable for this later setting than they were in the special setting used by the Bureau of Mines. It should be remembered however, that narrow gas passages without arches or wing walls conduce to gas and air stratification at too high combustion rates and high gas velocities.

The value of combustion volume is widely appreciated, however, as shown by the progress made in setting boilers high above the floor line. Eight feet was the highest a few years ago; those who had set boilers (B. & W. type) this high, went to 10 and 12 ft. on later installations. Today 12 ft. is common, and one finds 13 and 14 ft. in the very latest installations.

In the articles that are to follow, the latest and best boiler settings for the various boilers will be shown. All chief dimensions will be given. These settings are well suited to the high-volatile coals of the Middle West and, successfully burning these, they will burn any high-volatile coal obtainable on this continent. The next article will treat of settings for chain-grate stokers.

Spring Meeting of the A. S. M. E.

(*Continued from page 755*)

Middle West." In the topical discussion during this session some unusually interesting papers are expected. Other papers to be presented include: "Foundry Cost and Accounting System," by W. W. Bird; "The Public Interest as the Bedrock of Professional Practice," by Morris L. Cooke; "Moisture Reabsorption of Air-Dried Douglas Fir and Hard Pine, etc.," by Irving H. Cowdrey; "A High Speed Air and Gas Washer," by Lieut. J. L. Alden; "Investigation of the Uses of Steam in the Canning Industry," by J. C. Smallwood. On Thursday forenoon at the general session will be given the following papers: "Efficiency of Gear Drives," by C. M. Allen and F. W. Roys; "Self-Adjusting Spring-Thrust Bearing," by H. G. Reist; "Air Propulsion," by Morgan Brooks; "The Elastic Indentation of Steel Balls Under Pressure," by C. A. Briggs, W. C. Chapin and H. G. Heil; "Electric Heating of Molds," by Harold E. White; "Stresses in Machines When Starting or Stopping," by F. Hymans. Wednesday afternoon tea will be served at the Tatnuck Country Club, and on Thursday dinner will be served at the Worcester Country Club, followed by a lecture by Dr. S. I. Bailey on "Harvard's Contribution to Astronomy."

Co-operation of Public-Service and Isolated Plants

By Harold L. Alt

A rather original solution of the difficulty between the central station and the isolated plant was presented by Mr. Evans in the Apr. 23 issue of *Power*, and all credit is due him for a unique suggestion which no one else has thus far conceived. In fact, the proposition seemed so unusually good that an endeavor to check his figures was made; but here difficulties arose. To clear up the matter, I append the figures I have obtained, in the hope that Mr. Evans will point out the reasons for the discrepancies.

The heating season is usually considered as extending from Oct. 15 to Apr. 15, a period of 180 days, or, in other cases, 200 heating days. Allow 210 days for the sake of liberality, or 30 weeks. From this must be deducted 30 Sundays and the holidays of Thanksgiving, Christmas, New Year and Election Day, or 34 days in all, leaving 176 actual working days. Heating, of course, must be provided on all days.

Assuming a working day of 9 hours and a heating day of 18 hours, there must be $176 \times 9 = 1584$ hours requiring power and $210 \times 18 = 3780$ hours requiring heating, so that there will be $3780 - 1584 = 2196$ hours of heating without power. Mr. Evans, however, claims a total of 5832 hours, of which 2050 require power and 3782 require heat without power. Where does the larger amount come from?

The industrial plant assumed by him contained 1000 hp. in high-pressure boilers for heating in zero weather. This 1000 hp. apparently means developed boiler horsepower, which is roughly $1000 \times 32 = 32{,}000$ lb. of high-pressure steam produced per hour in zero weather only. At other times the amount is proportionately less, depending on the outside temperature.

Mr. Evans claims 34,000 lb., but it is not clear where he gets the larger amount, as one boiler horsepower is 33,479 B.t.u. At 150 lb. gage, with feed water at 200 deg. F., the heat required to produce 1 lb. of steam is $1195 - (200 - 32) = 1027$ B.t.u., and $33{,}479 \div 1027 = 32.6$ pounds.

As the average temperature for the heating season is 35 deg. F., or half the maximum temperature difference, the amount of steam developed for heating per year will be $3780 \times 32{,}000 \div 2 = 60{,}480{,}000$ pounds.

If the heating water from the combined converter-condenser is supplied to the buildings at 180 deg. F., with a maximum drop of 10 deg. in the transmission lines, it must leave the converter-condenser at $180 + 10 = 190$ deg. F. As it would hardly be practicable in a surface condenser to have the water approach the steam temperature within 10 deg., the maximum exhaust temperature on the coldest days will be $190 + 10 = 200$ deg. F., which corresponds to a vacuum of 6 in. of mercury. As the limit of vacuum practicable for regular work is about 28 in., it follows that the exhaust from the turbine would fluctuate between 6 in. of vacuum on the coldest days and 28 in. on the mildest days, or an average of 17 in. for the heating season.

No superheat is considered, as it is not mentioned. A large turbo-generator operates on from 15 to 18 lb. of steam per kilowatt-hour, with steam at 190 lb. gage, 125 deg. F. of superheat and a vacuum of 28 in. A decrease of 1 in. of vacuum increases the steam consumption about 3.5 per cent., and a decrease of 10 deg. of superheat increases the steam consumption 1 per cent. With 17 in. vacuum as an average, the reduction of vacuum is $28 - 17 = 11$ in., which would increase the steam consumption $11 \times 3.5 = 38.5$ per cent. The lack of superheat would increase it $125 \div 10 = 12.5$ per cent. So the total increase of steam consumption would be 51 per cent., or 1.51 times as great.

Under the conditions assumed, the minimum steam consumption would be $15 \times 1.51 = 22.65$ lb. per kw.-hr. and the maximum would be $18 \times 1.51 = 27.18$ lb. per kw.-hr., giving an average of approximately 25 lb. per kw.-hr. As the turbine must run under all sorts of fractional loads, the rate would probably be at least 30 lb. per kw.-hr., especially with steam at 150 lb. or less, instead of the 190 lb. on which the foregoing figures are based.

With a production of 60,480,000 lb. of steam in a season, it would be possible to develop $60{,}480{,}000 \div 30 = 2{,}016{,}000$ kw.-hr. As the maximum steam production on a zero day is 32,000 lb. per hour, and the turbo-generator takes about 30 lb. per kw.-hr., the size of unit required to utilize all the steam will be $32{,}000 \div 30 = 1066$ kw., or about 1000 kw., as suggested by Mr. Evans.

In the normal power plant, about 15 per cent. of the power produced is required for the operation of the plant accessories—forced draft, boiler feed, vacuum pumps, stoker engines, etc. In this case probably another 10 per cent. will be required to drive the circulating pumps for hot-water heating, which are usually of the centrifugal type and have a low efficiency.

A loss of $15 + 10 = 25$ per cent. of the total power generated would leave 75 per cent. available, or $2{,}016{,}000 \times 0.75 = 1{,}512{,}000$ kw.-hr. At Mr. Evans' figure of 1c. per kw.-hr. this would amount to $15,120 per season, as compared with his figure of $46,656. At $100 per kilowatt, the 1000-kw. plant would cost $100,000 and the interest and depreciation at 10 per cent. would be $10,000. At $0.0033 per kw.-hr. the supplies and other expenses would be $1{,}512{,}000 \times \$0.0033 = \$4990$. The total cost of running the plant would then be $14,990 a year, and the saving "to be divided as mutually agreed" would be $15,120 — $14,990 = $130 per year.

Mr. Evans has an item of $7125 which further subtracts from the value of the current produced and he explains this charge as "extra coal over heating requirements at $5 a ton." This is equivalent to charging up $7125 \div \$5 = 1425$ tons of additional coal. If (according to his figures) it takes 34,000 lb. of steam per hour in zero weather and he heats for a total period of 5832 hours, then his yearly steam consumption for heat must be $(34{,}000 \div 2) \times 5832 = 99{,}144{,}000$ lb. At 8 lb. of steam per pound of coal, this is equivalent to 12,393,000 lb. of coal, or about 6196 tons, burned to provide heat.

To run the 1000-kw. turbo-generator at full load at all times during the heating season would require

approximately a steam production equal to the maximum heating requirement at all times, or just about twice the heating coal, which is 6196 tons, based on his figures. Therefore, the purpose of the additional 1425 tons is not clear, as it does not represent a sufficient quantity of coal to run the turbine on full load for 5832 hours.

Now as to the fuel consumption. All power is being purchased from the central station, where it is generated at 2 lb. of coal per kilowatt-hour, according to Mr. Evans' supposition. If the 1000-kw. machine requires 30 lb. of steam per kilowatt-hour and the evaporation is 8 lb. of steam per pound of coal, then each kilowatt-hour produced by the machine means $30 \div 8 = 3.75$ lb. of coal. Accordingly, every hour the 1000-kw. machine is run on steam not generated for heating purposes, there is an increased fuel consumption of $(3.75 - 2) \div 2 = 0.875$, or 87.5 per cent.

This proves that the turbine in order to economize fuel consumption must be run on the steam that would otherwise be generated for heating only and must be run so as to utilize this steam alone and at such times and at such load as this quantity of steam makes it possible to carry.

The foregoing figures are not quite fair, however, as the central station uses about 2.9 lb. per kw.-hr. and probably loses 10 per cent. in transmission to the building, so that the actual figure for the central station will be $2.9 \div 0.90 = 3.22$ lb. as compared with 3.75 for the isolated plant. The isolated plant would then be in excess of the central station by $(3.75 - 3.22) \div 3.22 = 0.164$, or 16.4 per cent.

Operation and Maintenance of Elevators—Arrangement of Cables

By R. H. WHITEHEAD

Different schemes of roping up the winding-drum type of elevator machine, for both overhead and basement installations, are described. The limitations of these installations are also pointed out.

THE standard-elevator installations, Figs. 1 and 2, have two ropes from the winding drum to the car and two from the winding drum to the drum counterweight. Each of these pairs of ropes lead off from diametrically opposite sides of the drum, as shown at *A* and *B*, Fig. 1. *A* is the car-hoisting cables and *B* the drum-counterweight cables. The vibrating-sheave shaft and one bearing pedestal have been cut away to show the way the cables come down to the drum.

The grooving in the drum is generally arranged so that both sets of ropes use the same grooves; that is, when the car is traveling up the hoistway, the car-hoisting ropes wind on the drum and occupy the grooves that are vacated by the drum-counterweight cables, simultaneously unwinding off the drum, and vice versa for the downward travel of the car. This arrangement enables the drum to care for almost twice the rise that would be possible otherwise, since the rise of this type of elevator is limited by the amount of rope that can be wound on the drum.

For a standard installation where the elevator machine is located below, as in Fig. 1, the drum is generally continuously and spirally double-grooved in one direction and this double grooving may be either right-hand or left-hand. It is important that the angle at which the ropes lead off the drum be kept very small. This angle is denoted by *A* in Fig. 3. As shown in the figure, the angle is made minimum by locating the machine so that the cables, as they wind on and unwind off the drum, will be vertical when the car and counterweight are in mid-position in the hoistway.

When the car is at the top of the hoistway, the maximum amount of car-hoisting rope is wound on the drum, but allowance is always made on the drum for winding additional rope in case the car travels beyond the top landing. As the car descends, the hoisting ropes unwind, until finally, when the car is at the bottom of the hoistway, there remain, as a safety feature, about two complete turns on the drum to take care of any condition where the car might happen to run below the bottom landing. The drum-counterweight ropes lead off from the opposite side of the drum, as shown in Fig. 1, and are fastened to the extreme left of the drum, as at *R*.

When the car is at the top of the hoistway, the drum counterweight is at the bottom, consequently there are only a few turns of drum-counterweight rope on the drum for this position. As the car descends, the car-counterweight ropes are wound on the drum a few turns after the grooving has been vacated by the unwinding of the car-hoisting ropes. For low-rise machines, however, one half of the drum may be used exclusively for the car-hoisting ropes, and the other half for the drum-counterweight ropes.

The different methods of roping up the counterweights are also shown in Figs. 1 and 2. In Fig. 1, with the machine located in the basement, the drum-counterweight cables come down between the car-counterweight cables, pass through the center of this counterweight and are fastened to the center of the drum counterweight at *E*. For the overhead machine the drum-counterweight ropes come down, one on each side of the car-counterweight ropes, pass down through the car counterweight near its ends and are fastened to the drum counterweight at *E* and *E*.

In Fig. 7 a view is shown looking down the hoistway from above when the counterweights are located at right angles to the machine. The location of the overhead sheaves is shown and the general outline of the machine below. The length of the drum in a basement installation cannot be greater than the width of the hoistway, consequently, as the amount of rope that can be wound on the drum depends on the length of the

FIG. 1. BASEMENT INSTALLATION OF WINDING-DRUM TYPE ELEVATOR MACHINE

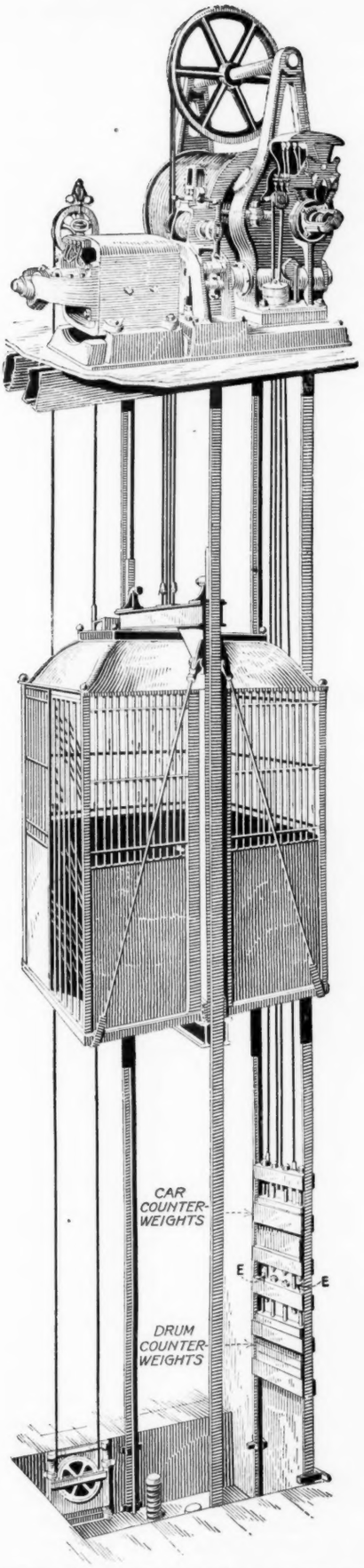
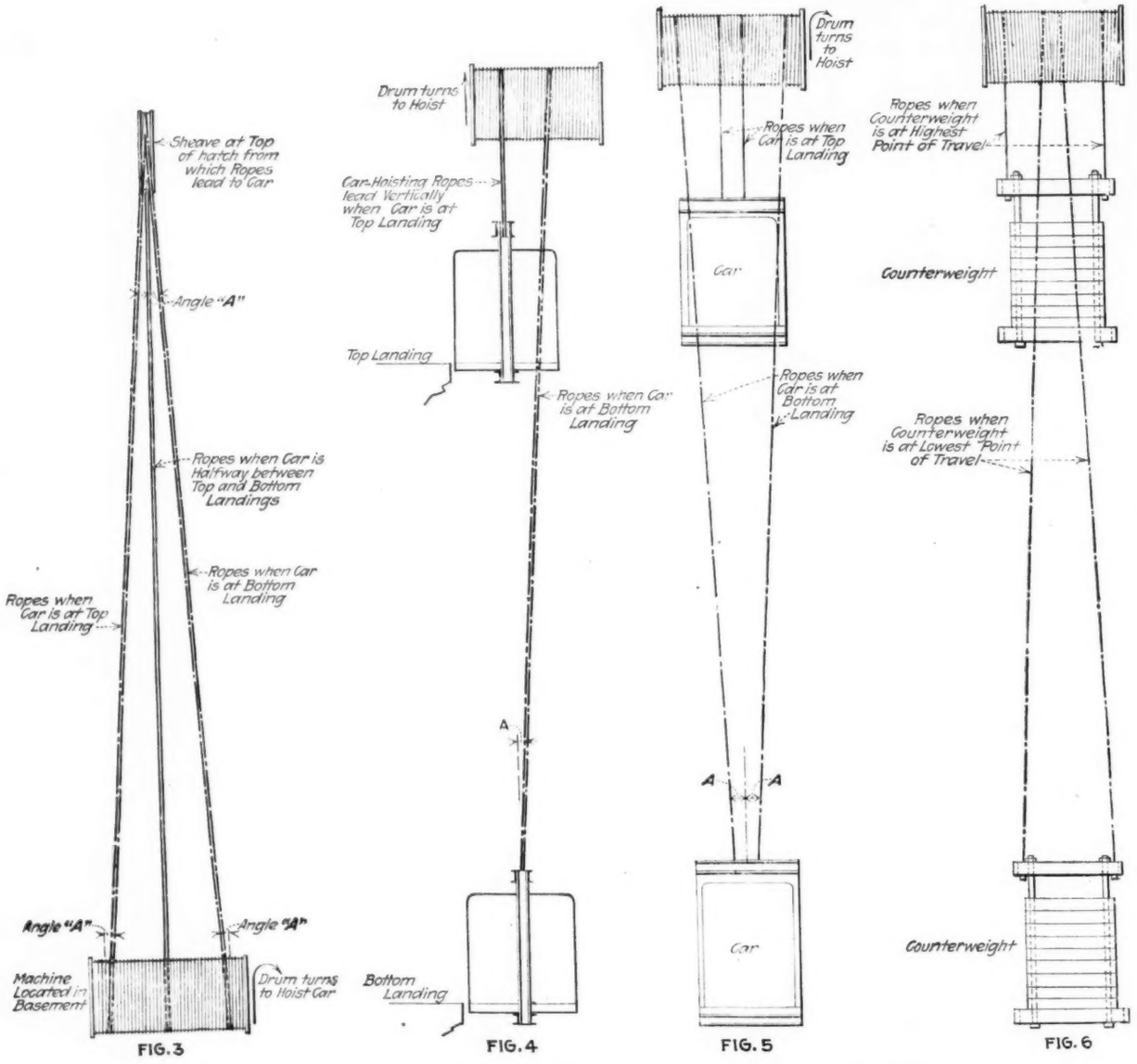


FIG. 2. OVERHEAD INSTALLATION OF WINDING-DRUM TYPE ELEVATOR MACHINE

latter, the possible rise of the car is limited by this factor. The diameter of the drum of such a machine is limited by consideration of elevator speed and space conditions.

When the elevator is overhead, as in Fig. 2, the grooving becomes a different proposition. Fig. 4 shows the rope lead when a continuously double-grooved drum machine, normally used on a lower floor or in the basement, is placed overhead. When the car is near the top drum is spirally grooved right-hand and the other left-hand, as shown in Fig. 5. With this arrangement the side thrust on the car caused by one of the ropes is offset by that of the other. In Fig. 5, when the car is at the top of the hoistway, the lead of the hoisting rope must be as shown—that is, from a position near the center of the drum—and as the car descends, the two car-hoisting ropes travel in opposite directions along the face of the drum toward the flanges. The


Sheave at Top of hatch from which Ropes lead to Car
Angle "A"
Ropes when Car is Halfway between Top and Bottom Landings
Ropes when Car is at Bottom Landing
Ropes when Car is at Top Landing
Angle "A"
Angle "A"
Machine Located in Basement
Drum turns to Hoist Car
FIG. 3
Drum turns to Hoist
Car-Hoisting Ropes lead Vertically when Car is at Top Landing
Top Landing
Ropes when Car is at Bottom Landing
A
Bottom Landing
FIG. 4
Drum turns to Hoist
Ropes when Car is at Top Landing
Car
Ropes when Car is at Bottom Landing
A
A
Car
FIG. 5
Ropes when Counterweight is at Highest Point of Travel
Counterweight
Ropes when Counterweight is at Lowest Point of Travel
Counterweight
FIG. 6

FIGS. 3 TO 6. DIFFERENT ARRANGEMENTS OF CABLES FOR ELEVATOR MACHINES

of the hoistway, the length of car-hoisting ropes from the drum to the car may be only three or four feet. Therefore, for this position of the car, in order to have a good lead on the ropes, the latter must come down vertically from the drum to the car. As the car descends, the ropes lead off from the car crosshead at an increasing angle to the vertical, as at *A*. Where the distance is greater than about 35 ft., this arrangement causes an undesirable side thrust on the car, and friction between the car shoes and the guide rails.

To avoid this disadvantage for high rises, a single spiral groove is used on the drum. One half of the ropes are fastened to the opposite ends of the drum's face. This arrangement gives the best rope lead for all conditions. Both drum-counterweight ropes are fastened at the center of the drum's face.

When the car is at the top of the hoistway, there are three or four turns of the drum-counterweight rope wound on each set of grooving between the car-hoisting ropes; the latter, for this position, are fully wound up on the drum. As the car descends and the car-hoisting ropes unwind, the drum-counterweight ropes occupy the vacated grooving on the drum as it revolves. This permits of the maximum economy of drum surface, and

thus with an overhead machine it is possible to have the same rise as with a machine located below.

Fig. 6 shows how the proper lead of drum-counterweight rope is maintained. The width of the counterweight is approximately the same as the length of the drum, so that when the counterweight is near the top of the hoistway, the counterweight ropes will lead vertically from the face of the drum to the counterweight, and each of the ropes is at the same time about a maximum distance from its central position along the face of the drum. The ropes are therefore attached to the counterweights at points spaced apart equal to the maximum distance they are separated on the drum, when the counterweights are at the top of the hoistway. For high rises wide counterweights are required, but for all rises the proper proportion of width to the length of the counterweight must be maintained to avoid a condition that would cause them to jam, similar to that effect which sometimes occurs on opening a bureau drawer.

With an overhead machine the drum diameter is limited by the distance from the center of the car to the center of the counterweight. This is shown in

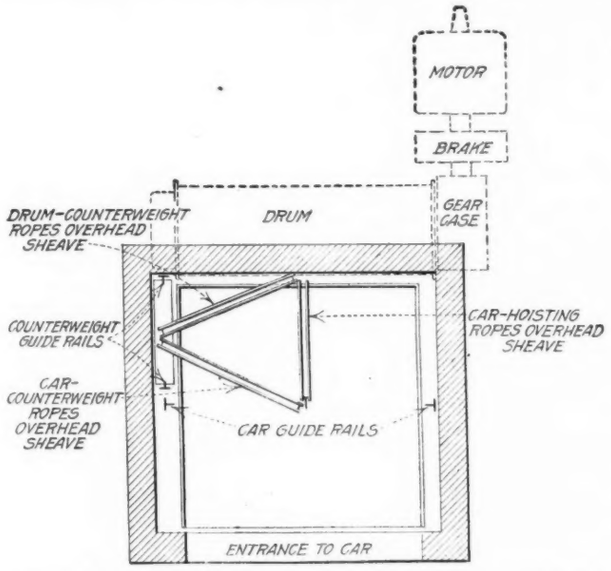


FIG. 7. LOCATION OF OVERHEAD SHEAVES WHEN MACHINE IS PLACED AT RIGHT ANGLES TO COUNTERWEIGHTS

Figs. 8 and 9. If the machine does not span this distance, as in Fig 8, then a pair of detached vibrator sheaves must be used for the drum-counterweight ropes which move along a shaft parallel with the drum. If the drum does span the distance from the center of the car to the center of the counterweight, as in Fig. 9, no vibrator sheaves are needed for the drum-counterweight ropes. Such an installation is also shown in Fig. 2.

There are some cases with machines of either the overhead or basement type, where four car-hoisting ropes are required. With a basement-type machine it is not practical to groove the drum continuously with quadruple grooving, so that the ropes can travel side by side, owing to the large pitch of grooving that would be required. Consequently, when four ropes are required with machines of either type, the machine is grooved as in Figs. 5 and 6, excepting instead of single grooves, double grooves are used, and a pair of hoisting ropes is used on each end of the drum instead of a single rope as shown. The drum-counterweight ropes are cared for in a similar manner to that shown in Fig. 6.

The winding-drum machine, as explained, has certain definite limitations and cannot on this account be used for the high rises met with in our modern high buildings. Its use is generally limited to about a 15-story

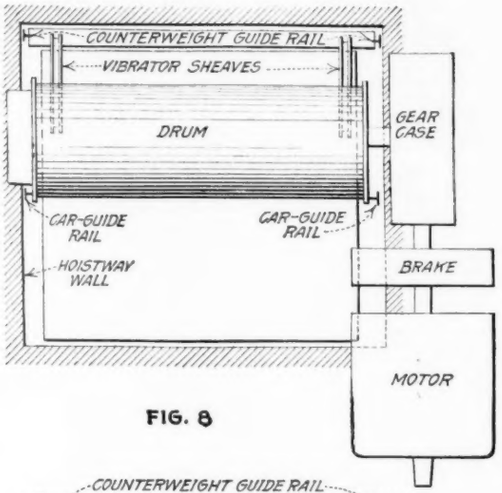


FIG. 8

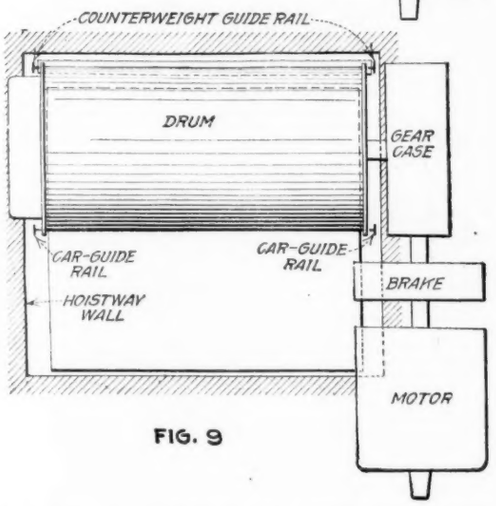


FIG. 9

FIGS. 8 AND 9. LAYOUTS OF OVERHEAD MACHINES

building although, as explained, this depends on the particular characteristics of the installation. The next article will deal with the operation of traction-type elevator machines, which have practically no limitations as far as the length of the rise is concerned.

Something About the Steam Loop

A few nights after the Saturday afternoon chat Willis had with Williams at the Stahley plant, he dropped in again, as he was on his way home for supper, to have another talk about the action of the steam loop. Williams was washing up when Willis breezed into the engine room with the remark, "I got here just in time to keep you on the job a little longer than the law demands. I guess you don't mind, do you?"

"Not so as you would notice it, seeing it's you. What's on your mind tonight?" replied Williams.

"Well, last Saturday afternoon we had a little confab

about pumps, and you was cussin' 'em up hill and down and wished that some fellow would get up something that would handle hot water without any moving parts. I told you that I would give you a few pointers about the steam loop, and here I am to carry out my part of the contract."

"All right, go to it. Better take a chair and be as sociable as you can while I get into my street togs. I can listen just as well as not while I am changing."

"All right, here goes. A steam loop is a device for returning condensation from steam pipes, separators, radiators and other parts of a steam plant to a boiler, when there is not an excessive pressure between the boiler and the different parts of the system. To do that, water has to be carried from some part of the system of less pressure than is carried in the boiler and delivered to the boiler where there is a higher pressure than is carried in the piping system of the plant."

"Why the drop in pressure? If you turn steam into a pipe line, you will get the same pressure all along its length, won't you?"

"Not so as you would notice it," replied Willis. "If you don't believe it, you put a gage on the steam pipe next to your engine and you will find that there is a few pounds less pressure there than at the boiler; this is due to the length of the pipe and the number of fittings, the velocity of the steam flow and the amount of condensation that takes place. Now to get the water of condensation back to the boilers, it is generally necessary to overcome the drop in pressure and also the weight of the water or hydraulic head if you want to

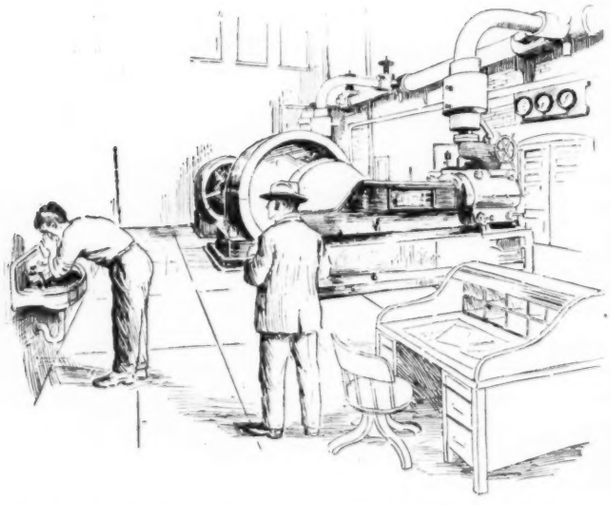


FIG. 1. "I GOT HERE JUST IN TIME TO KEEP YOU ON THE JOB A LITTLE LONGER"

be technical, so to speak. The beauty of a steam loop is that it will handle water with pretty near no attention, and all of the work done by it is due to the condensation of steam in the apparatus."

"That may all be; but how is the thing made?" asked Williams.

"It is simple in construction and consists of but three parts—two vertical pipes and one horizontal. Perhaps I had better make a sketch so as to make the matter plain." (See Fig. 2.) "The pipes I will mark *A*, *B* and *C*. The vertical pipe *A* is called the drop leg, the connecting pipe *C* the horizontal and the pipe *B* the riser, the last being connected to the steam separator *D* of the engine."

"That's a funny arrangement," said Williams as he examined the sketch. "What does it do?"

"Just what I have been telling you. It will take the vapor that collects in the separator just as fast as it accumulates and return it to the boiler, and it won't

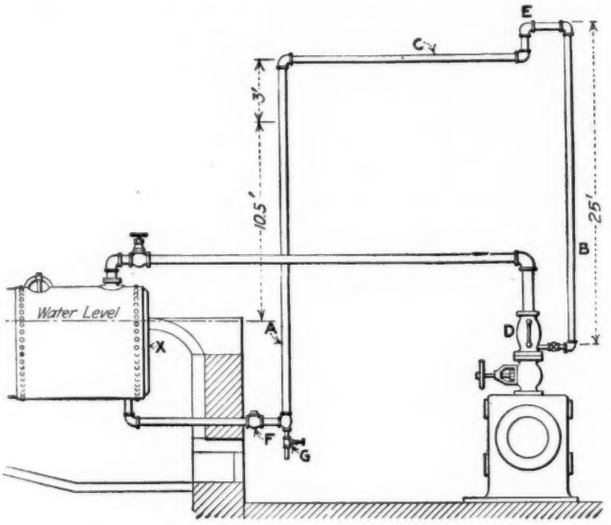


FIG. 2. LAYOUT OF A STEAM-LOOP SYSTEM

allow a lot of water to collect in the separator before it begins to operate. Now to have the system work as it should, it is necessary to have the pipes proportioned right. Added to that, the vertical pipes should be covered with some insulating material, but the horizontal pipe *C* should be left bare. Under ordinary conditions the pipe *C* will act as a condenser and the loop *E* prevents the water from running back into the riser *B*."

"I don't believe the thing will work," Williams exclaimed after examining the sketch once more; "that is, I don't believe it will the way you have got it drawn. Where is the steam coming from to be condensed in the horizontal pipe *C*? You haven't made any connection to the steam space of the boiler."

"Well, I declare, that was careless of me, wasn't it?" replied Willis. "Of course, if that pipe is going to act as a condenser it has got to have steam to condense and, as you say, it can't come from the boiler because there ain't no steam connection and it can't come from the blowoff connection because there is water in it up to the water level in the boiler, and a check valve prevents it from going higher. I swan, I don't see how I came to make that mistake, but perhaps there is another way for that pipe to get steam for condensing purposes," and Willis indulged in a slight grin as he continued:

"The condensation and entrained water in the separator are in the form of a moist vapor, with a low specific gravity, which rises to the condenser *C* and is turned into water. This will go on as long as there is vapor, and when the water running into the drop leg *A* reaches a height sufficient to overcome the pressure on the check valve *F*, it will run into the boiler. The weight of a cubic foot of water depends on its temperature. At 60-lb. gage pressure the temperature would be about 307 deg., using round numbers, and at, say, 110-lb. pres-

sure it would be about 344 deg. The weight of a cubic foot of water at the corresponding temperatures would be about 57 and 56 lb., respectively. Now, a column of water 1 in. square and 1 ft. high weighs, at your pressure of 110 lb., which equals 344 deg. temperature, 56 ÷ 144 = 0.388 lb. That being a fact, the height of the column of water in the pipe *A* with, say, a 4-lb. difference in pressure between the boilers and the engine would be 4 ÷ 0.388 = 10.3 ft."

"All right, I will take your word for it, so go to it."

"If the water in the pipe *A* is to run into the boiler, you can see that the height of the water must be enough to overbalance the difference in pressure, as well as what friction there may be. In order to do this the pipe *A* has got to be about 30 per cent. higher than the height of the column of water that we found was necessary to balance the difference in pressure due to the drop between the boiler and the engine, or 10.3 ft. Then 10.3 × 0.30 = 3.09 ft., which, added to the height of the water necessary to overbalance the difference in pressure, will be 10.3 + 3.09 = 13.39 ft., or 13.5 ft., the height of the pipe *A* above the water level in the boiler. The head of water tending to force the check valve *F* open is equal to the height of the pipe *A*, less the height necessary to balance the difference in pressure. You get this by multiplying by 0.388, the weight of a column of water 1 in. square and 1 ft. high, as we have already found. Then 13.5 — 10.3 × 0.388 = 1.24 lb."

"Does it make any difference where the pipe *A* enters the boiler; that is, below the water level?"

"If you will stop to think a moment, you will see that it does not. In the sketch the water enters through the blowoff pipe. It could have entered the boiler at the point, say, *X*, just as well, as it does not affect the working of the system."

"I don't see why it won't make a difference, because the column of water is higher with the lower connection than with the higher one."

"Well, well, it does look as if that were so, don't it, from the standpoint of the water in the pipe *A*? But ,on the other hand, with either a lower or higher connection, the height of the horizontal pipe *C* above the water level in the boiler will be the same, because its height is always measured from the water level in the boiler.

"Don't you see that the total difference in pressure is balanced by the height of water column in the drop leg and as the horizontal pipe is a condenser the vapor is drawn into it when it condenses and runs down into the drop leg? Then, just as soon as the column of water reaches a height sufficient to overcome the balance, the check valve opens and the water flows into the boiler, and that is about all there is to it."

"That sounds easy. I wonder that there are not more of them working in steam plants."

"Now you come to mention it, there are a lot of them operating in power plants. They take up so little room that a fellow don't see them when he goes through a plant where they are. One thing that should be remembered is to have the check valve *F* of large area, because if there is much difference in area between the top and the bottom it will prevent the check from lifting until a greater column of water has gathered in the drop leg than is necessary for its operation after the check does lift."

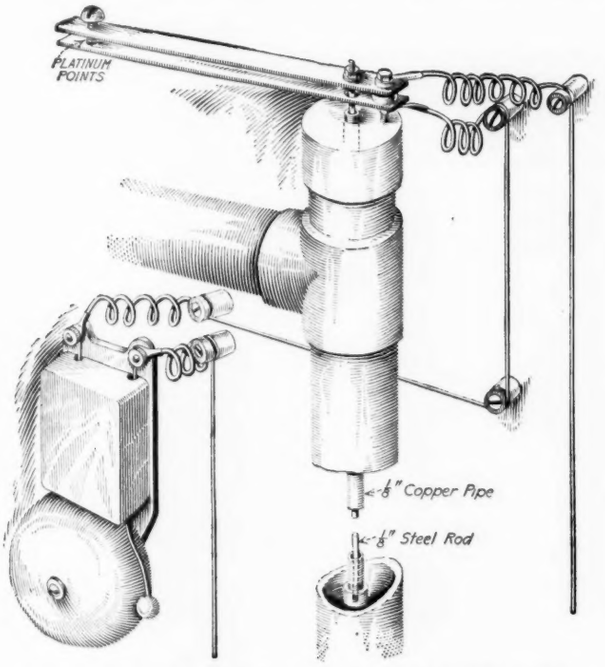
"What's the odds if it does get more water than is necessary to operate? Can't do any harm, can it?"

"The only harm that it would do would be to flood the horizontal pipe *C* and that would, of course, prevent the system from operating. Another thing that will prevent the system from operating is when it gets airbound. That is what the valve *G* is put on for so as to let the steam, water and air blow out when it is opened and so clear the system of air. Then close the valve and away the system will go as slick as a brindle pup chasing a tomcat."

High-Temperature Alarm

BY HERBERT B. BRAND

The device shown in the illustration is for giving an alarm when the temperature of the cooling water, from the jacket of an oil engine or air compressor or the oil in the lubricating system of an engine or turbine,



BELL CIRCUIT CLOSED BY RISE IN TEMPERATURE

reaches a predetermined point. It consists of a ⅛-in. copper tube (iron-pipe size) 20 in. long, one end of which is screwed into a 1½-in. pipe cap (or other size to suit the piping used). A ⅛-in. steel rod 23 in. long is screwed into a ⅛-in. pipe cap at the lower end of the copper tube. The free end of the steel rod where it projects from the copper tube at the top is threaded for about one inch of its length. The arrangement for increasing or multiplying the motion consists of two pieces of brass ¼ by ⅝ in. The movable member of this multiplying device carries a brass screw and locknut; the screw and lower contact preferably have platinum contact points. The action depends on the difference in the coefficient of expansion of copper and steel, so that when the copper pipe lengthens from a rise in the temperature of the fluid flowing in the large circulating pipe and the steel rod does not lengthen so much, the contacts will be brought together, closing the electric circuit and ringing the bell.

Radojet Air Pump

The satisfactory performance of a condenser depends largely on how the air and the condensates are removed, as air is a nonconductor of heat and it is necessary to remove it rapidly from the condenser as the steam is condensed; if not, it will collect and form a noncondensing element around the condenser tubes and impair the heat's transfer.

With reciprocating engines operating with a vacuum of about 26 in., the reciprocating air pump performed its function, but with the adoption of the steam turbine and its high vacuum, a demand for a condenser that would maintain a high vacuum was necessary and this, of course, required a further development of the water and air pumps.

An ideal air pump would be one in which there are no moving parts, simple in construction and operation, together with a low steam consumption, combined with the additional features of minimum space and weight, no foundation, noiseless operation and no attention during operating period, quick starting, continuous service and safety of operation. Such an air pump has been developed by the C. H. Wheeler Manufacturing Co., 18th St. and Lehigh Ave., Philadelphia, Penn. It is called Radojet and is used in connection with surface, jet or barometric condensers, as well as in combination with other apparatus, wherein a vacuum has to be produced and maintained.

The principal characteristic of the Radojet air pump, Fig. 1, is the use of the steam jets for the removal of

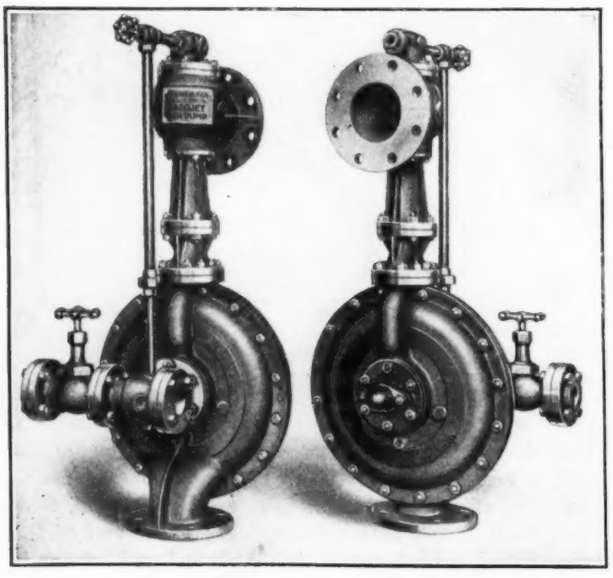


FIG. 1. TWO VIEWS OF THE RADOJET AIR PUMP

air. Although this method of removing air is not original with this pump, it has never before been developed to produce high vacuum commercially. The Radojet consists of two steam ejectors working in series, Fig. 2, the top ejector being called the first stage and the lower one the second stage.

A study of Fig. 2 will show how the pump operates. Live steam at boiler pressure enters through the flanged connection *A* and strainer *B* to the expansion nozzles *C*, the path being through the pipe *D*, angle valve *E* and strainer *F*. From the expansion nozzles the steam flows across the suction chamber *G* of the first-stage ejector, which is connected to the condenser through the flanged opening *H*. As the steam expands in the nozzles *C*, it leaves them at a very high velocity, and in crossing the suction chamber *G*, it entrains the air and vapor coming from the condenser. The mixture of steam, air and

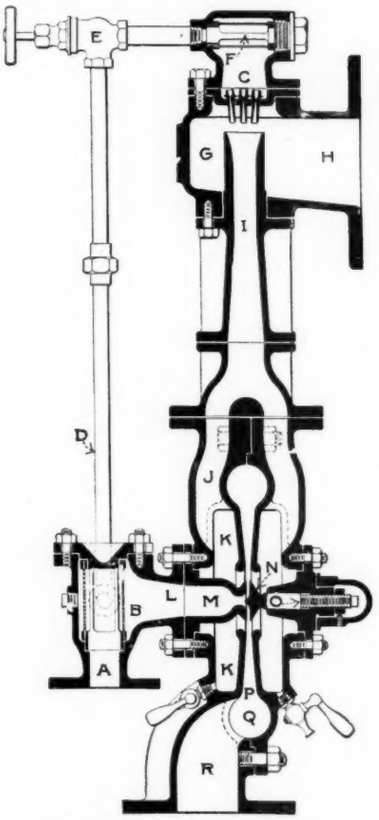


FIG. 2. SECTION THROUGH RADOJET AIR PUMP

vapor passes into the diffuser tube *I*, from which it is discharged at a higher absolute pressure than that of the air entering at the opening *H*, into a double annular passage *J* which communicates with the suction chambers *K* of the second-stage ejector.

Steam is simultaneously delivered through the strainer *B* into the passage *L*, which communicates with the annular expansion nozzle formed between the two circular disks *M* and *N*. The disk *N* can be adjusted toward or away from the disk *M* by the adjusting screw *O*. This is to vary the cross-section of the nozzle passage and thereby change the expansion ratio of the steam.

The steam from the chamber *L* is delivered radially by the annular nozzles *M* and *N* and expanding leaves it as a jet of high velocity in the form of a sheet, and in passing the suction chamber *K* entrains the air and steam coming from the first-stage nozzle and carries them into the annular diffuser *P*, thus compressing the mixture to atmospheric pressure and discharging it into the casing *Q* and out through the discharge opening *R*. The discharge from the outlet *R* may be delivered into a vented tank supplied with fresh water for boiler heating where the steam contained in the mixture is condensed.

The air frees itself from the water and escapes through the vent to the atmosphere. If an open feedwater heater is used, the discharge from the air pump is led directly to it.

In Fig. 3 is shown a surface-condenser installation fitted with Radojet air pumps arranged on a common air-suction header for removing the air. This arrangement provides for different loads and for cutting out one or more air pumps when desirable. It also prevents a total shutdown due either to an unexpected leak or a breakdown.

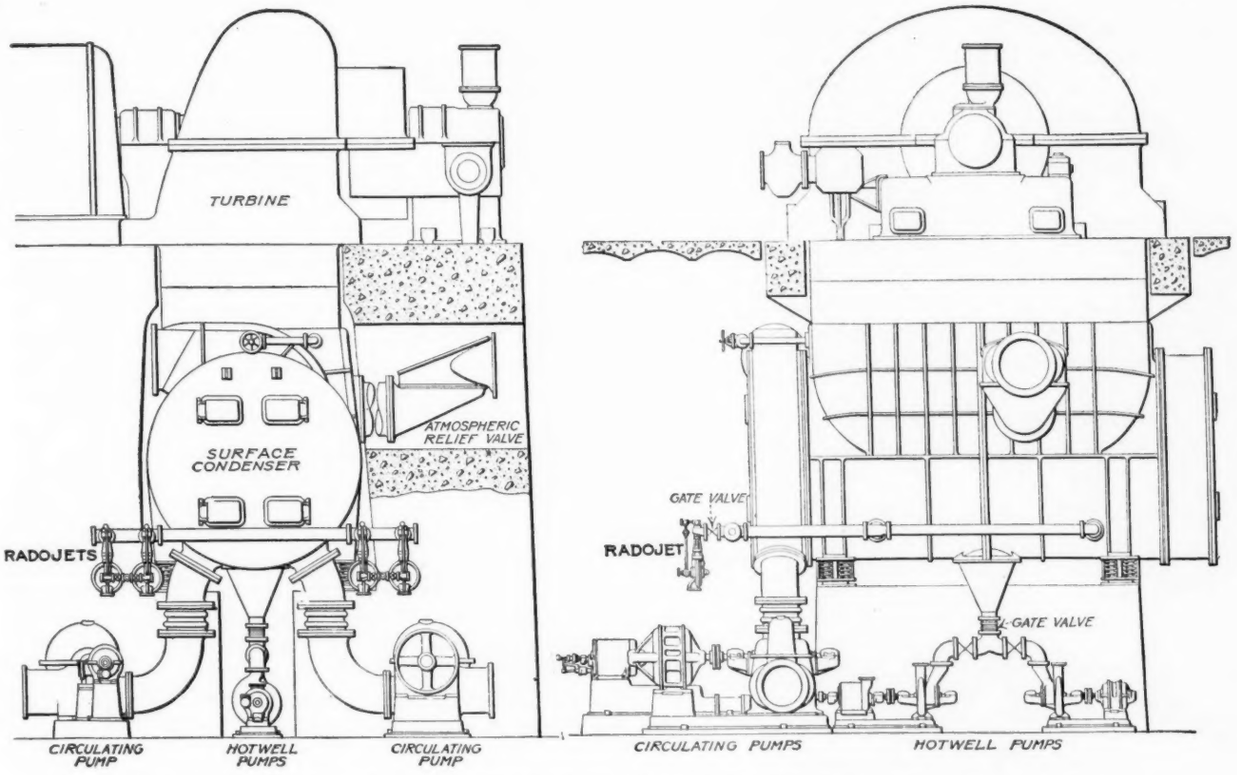


FIG. 3. END AND SIDE VIEW OF SURFACE CONDENSER EQUIPPED WITH RADOJET AIR PUMPS

This type of air pump, when used with the jet type of condenser, has the advantage of independent operation and being separated from the removal pump in that the air pump is started independently of and prior to the removal pump; and because of its ability to handle a large volume of free air even at low vacuum, it quickly creates the pressure difference necessary to lift the injection water. The action of this air pump is such that within one to three minutes from the start (depending on the size of condenser) the main injection valve can be opened, and simultaneously putting the removal pump in operation, the condenser is ready for service. This independence of the air pump makes it possible to vary the speed of the removal pump according to the variations in the discharge heads, thereby obtaining the most economical results.

Fig. 4 shows the application of this design of air pump to a low-level jet condenser. When used on large-sized condensers, two or more air pumps working in parallel are arranged. This gives the advantages mentioned in connection with surface condensers. This air pump will work with the barometric type of condenser equally as well as with those of the surface and jet types.

Owing to the absence of moving parts, this air pump does not require attention during operation, and when once adjusted and supplied with dry saturated steam of the designed pressure, it will maintain continuous service. When starting, the valve controlling the steam supply is opened and that is all there is to it.

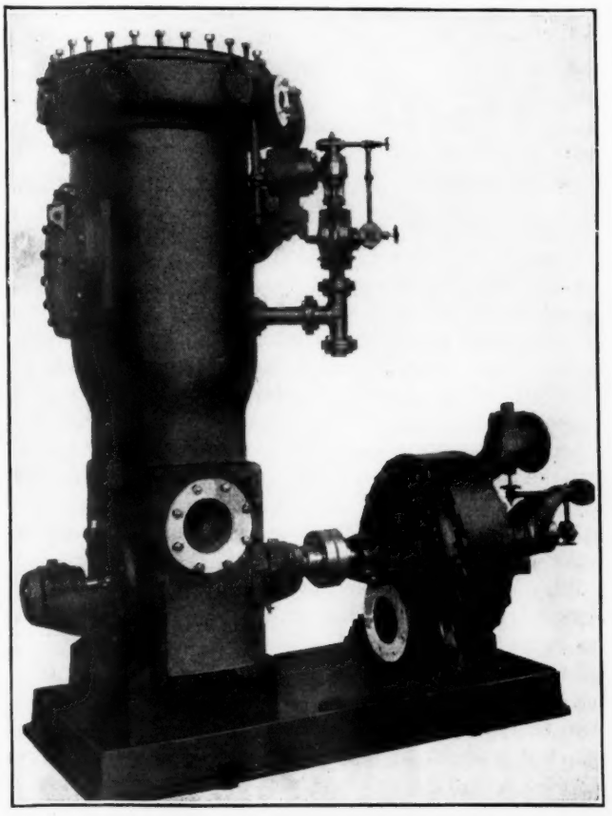


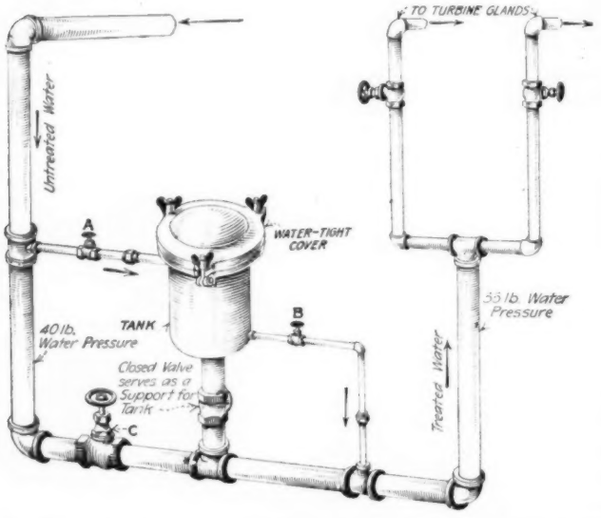
FIG. 4. RADOJET AIR PUMP ATTACHED TO A JET CONDENSER

Purifying Water for Sealing Steam Turbine Glands

By J. B. Linker

In a steam-turbine installation, the glands should be sealed with soft or purified water. This is easily obtained in a plant where condensed steam is available; but in many plants such a supply is not at hand, and other means must be found to keep the glands from becoming clogged with scale. If the glands clog with scale, the runners are liable to be broken, and a kinked or unbalanced spindle may result. Many turbine owners and operators do not attach proper importance to the use of gland water that is free from impurities. The manufacturers of turbines offer arrangements for chemically treating gland water that contains impurities, and yet many customers will disregard this important matter.

The writer was called upon to start up a turbine, and on arriving at the plant found that no provision had



WATER-SOFTENING APPARATUS FOR STEAM-TURBINE GLANDS

been made for using purified or soft water on the glands. The owner wanted the turbine to be put into immediate service and ordered the machine started up by using well water that contained considerable magnesia. The writer informed the owner of the importance of using purified water, but owing to the necessity of getting the plant started, the water that contained the magnesia was used. After two weeks' operation the glands became so clogged with scale that the turbine was shut down for two days to clean the gland casings and runners. This owner doubted that two weeks' run with hard water would cause a shutdown, but it did, and he is now thoroughly convinced that it was a great risk to run. A system for using purified water was immediately installed.

On starting up another plant, the same problem of a lack of purified water was encountered. It was decided that this turbine would not be started until some means was found to supply soft water for the glands. It would have required several days to construct tanks and do the necessary pipe work for installing the chemical-feeding arrangement recommended by the turbine builders. To assist the owner to get the machine going as quickly as possible and at the same time take no chance of clogging the gland casings, a temporary arrangement was rigged up to treat the gland water with chemicals. The owner was using a small tank arrangement for feeding boiler compound to the feed water. It happened that an extra tank was available, and it was piped up as shown in the figure, to feed chemicals to the gland water. It took only a few hours' work to install this tank and get the turbine in service. The result was that any desired quantity of chemical could be fed to the gland water. The chemical used was the product of the manufacturer of the tank, which is designed particularly for use in treating boiler-feed water.

In starting the turbine, the two valves *A* and *B* were opened wide and the water pressure to the glands was controlled by the valve *C*. By having the two valves *A* and *B* open, and manipulating the valve *C*, water was forced through the tank, where it dissolved the chemical. The line pressure was about 40 lb. at the valve *C* and somewhat less at the discharge side of this valve. By regulating the opening of the valves *A* and *B*, any strength of solution desired could be obtained.

It is not the intention of the writer to introduce a new arrangement for treating gland water, but it is desired to emphasize the necessity of keeping scale from forming in the gland casings and on the gland runners of turbines requiring water seals. Once the owners and operators of steam turbines are convinced of the importance of this matter, no trouble will be experienced with clogged glands.

Trials of Marine Fuels

Among the efforts to relieve the exceptional present demand upon the liquid-fuel resources of the world is an attempt to burn a colloidal mixture of Navy fuel oil and pulverized coal. Successful runs have been made with the mixed fuel off New Haven upon a vessel which has been assigned to the Submarine Defense Association for this and similar purposes.

A material is in a colloidal condition—as that term has of late been used with regard to graphite mixed with oil, etc.—when it remains suspended in the containing fluid and will not, by reason of the fineness to which it has been reduced, settle out. About 3 parts by weight of coal can be carried in this way by 7 parts of oil, giving a mixture of about the same calorific value per cubic foot as the oil itself. This mixture can be used in the same burners as the plain oil and affords a means of replacing 30 per cent. of the liquid fuel by the more abundant coal and of burning the latter smokelessly and without any complication of the apparatus.

The tests, which are being run by Haylett O'Neill, combustion engineer, of the Submarine Defense Association, will comprise trial runs to determine the practical and comparative steaming values for marine practice of the following fuels: A combination fuel consisting of a colloidal mixture of Navy fuel oil and pulverized coal; Navy fuel oil; pulverized coal with installations by various companies; pulverized coal and Navy fuel oil burned simultaneously in respective burners under the same boiler; pulverized coal and colloidal fuel burned simultaneously in respective burners under the same boiler.

Editorials

Some Benefits of the War

GIGANTIC catastrophe as it is, the world war brings in its train a few effects which may be added to the credit side of the account.

One of the smaller of these is the effect which it has had upon the mental habits of the people. We know more of geography, of peoples and their history; we pay more attention to the utterances of the leaders of the world's thought; we have a keener perception of the social and industrial problems of life. The proletariat has taken to serious reading and thinking.

The war has forced upon us a demonstration of the possibilities of thrift. We have been a nation of spendthrifts. President Wilson said in his address to the War-Savings Committee: "I suppose not many fortunate byproducts can come out of a war, but if the United States can learn something about saving out of this war, it will be worth the cost of the war; I mean the literal cost of it in money and resources. I suppose we have several times over wasted what we are now about to spend. We have not known that there was any limit to our resources; we are now finding out that there may be if we are not careful." Many a person who would have spent his all as he got it will come out of the war with a snug little sum in Savings Stamps or Liberty Bonds, and even if enforced economies have demonstrated how much one can go without and inculcated the saving habit, it will be worth something.

Closely akin to enforced economy is enforced efficiency. Shortage in materials and man-power has driven us to making better use of what we have. The carelessness in the use of coal of the old plentiful days is no longer tolerated. The possibilities of cheaper fuels are demonstrated, wastes are discovered and stopped, fuel-saving devices are sought and used, and a premium has been put upon efficiency in the power plant. Owners, engineers and firemen are alive as never before to the savings that can be made, and a standard of efficiency is being established that will set a new pace when the war is over. The same thing applies in a broad sense to all industrial operations.

To those who participate in its various activities the war will bring many advantages in an enlarged experience of the world, in contact with other people and other lands, in associations and acquaintances and friendships, in honors achieved, in an outgrown provincialism and a sense of duty done.

It will greatly improve the physical powers of millions of men. The systematic régime of the training camps, the regular routine of the cantonments, and service in the field and in the trenches will strengthen and temper the country's manhood, the fiber of which had been in danger of becoming asthenic through ease and luxury. Similarly, the widespread employment of women in the industries will result in a decrease of idle and purposeless living and an improvement in physical well-being. So there must necessarily follow a tremendous expansion of our biological capital, the benefit of which the nation will receive in the coming generation.

The war will put America on an independent basis with regard to many things for which we have been dependent upon others. It has forced us into new lines of manufacture, such as dyes, chemicals, glass for optical instruments, nitrates. It is forcing us to develop our neglected resources, as the soda deposits of Utah, the water powers, the beds of lignite and peat. It has intensified the search for oil and compelled new methods of refining its most demanded products. It has stimulated invention and research and has led to the perfecting of numerous industrial processes of permanent value.

The war revived our drooping industries and has made us the creditor nation of the world. It has made work plentiful even though it has made living dear. It has opened to us the markets of the world and compelled us to build a merchant marine to reach them and financial and commercial organizations to cultivate them. It has given us a chance to demonstrate the integrity of our purposes, the unselfishness of our motives and the beneficence of our intentions toward all mankind, has allayed the distrust of our neighbors, disarmed the enmities which were brewing against us and bound us with new ties of sympathetic friendship to our Allies. It will win us the respect of an erstwhile contemptuous assailant.

It will sound the knell of attempts at empire building by conquest, by diplomatic duplicity, by spying, intriguing, the shameless abrogation of solemn pledges, bribery, trickery and the force of arms. It may lead to the substitution of the processes of civilization for the savage arbitrament of arms in the settlement of international disputes. It may lead several paces toward the Federation of the World, when all the wealth and energy and ingenuity which nations now expend in preparing for attack or defense can be devoted to the common good of that federation.

But perhaps the greatest good that can come to this country from the war is the impetus which it has given to the concept of national efficiency. The mobilization of the industrial, the agricultural, the transportation facilities of the nation for the purposes of war will suggest their mobilization and organization and systematization and correlation for the purposes of peace. The possibilities of intelligent, systematic, scientific regulation of the food and fuel supply, of a unified system of transportation, of business conducted with a view to the greatest over-all efficiency and the common good rather than to exorbitant profit and unnecessary opportunity for gain, will be so forcibly apparent that either by the voluntary coöperation of the participants or by the forceful imposition of the common will they will be realized.

The Engineer Coming Into His Own

EVER since the beginning of the development of engineering science the engineer has been willing to work along quietly, seeking his reward only out of the joy of his accomplishments. Great as these achievements were, only recently has it occurred to the engineer and the man of science that they were entitled to greater recognition in the affairs of state. For years the legislative bodies enacted laws both wisely and unwisely without even a semblance of approval or protest from the engineers of the country.

However, times have changed and the engineering profession is coming into its own; the engineer is beginning to speak for himself. He has learned the value of coöperative effort and coördinated action on the part of engineers of all classes. As a medium of coöperation between the engineering societies, the Engineering Council was formed last June, consisting of twenty-four representatives from the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Institute of Mining Engineers and the United Engineering Society, to speak authoritatively for the member societies on all public questions of interest or concern to engineers.

H. W. Buck, past president of the American Institute of Electrical Engineers, said in his presidential address, June, 1917: "It is an encouraging beginning toward universal coöperation among engineers in all branches of work. In this Engineering Council we have for the first time an engineering body representing some thirty thousand engineers of sufficient scope and standing to create an engineering public opinion. Its influence is likely to be far reaching in building up the prestige of engineers in both technical and civil affairs."

That the Engineering Council is making itself felt and through it the engineer as a force in affairs of government is evidenced by the resolution adopted by this council and presented recently to the National Industrial Conference Board, that the council was opposed to certain Navy and Army bills being considered by Congress, which contained proposals detrimental to well-tried industrial methods for improving efficiency and increasing production in manufacturing plants. It is gratifying to note that after expressing the opinion, "It appears that the members of the great engineering societies of the United States are peculiarly qualified by virtue of their knowledge and experience to express an opinion upon the present efficiency of our production and the most practical means of increasing the productive capacity of both management and men and to call to public attention questionable proposals threatening our efficiency as a nation and therefore our capacity to perform our full duty in this great struggle," the National Industrial Conference Board in a resolution "respectfully requested the engineering societies of the United States to investigate and to publicly express themselves as to whether or not we are losing or gaining in industrial efficiency, and to state what causes, if any, in their opinion are influencing the condition, in what manner broadly they believe our industrial efficiency can be further stimulated."

Is not this and many other instances that have taken place during the past year only the beginning of the important part that our engineers are destined to take in our Government in the future, a part that is justly theirs by virtue of their training and qualifications, such as judgment, character, human understanding, resourcefulness, etc.?

The Opinion of An American

ANOTHER great American engineer, Dr. John J. Carty, has been awarded the Edison Medal, as reported on another page of this issue. Dr. Carty no doubt is the greatest genius in the science of telephone engineering today, having attained his high position without a college education. Although the American people may well be proud to honor him as an engineer and scientist, they should be even more proud of his thorough American spirit and his confidence in the genius of the American people. This magnificent spirit of Dr. Carty is most eloquently expressed in his address on accepting the Edison Medal, in which he says:

> We hear a great deal about the German scientist and the wonderful things he has done and has been planning. Many years ago, when German "Kultur" was interpreted by many to mean German culture, it was suggested to me that we should send to Germany to get some of the Herr doctors to teach us the high science. I always opposed that, believing that the Yankee mind, the Yankee boy, when his attention was turned to scientific problems, would surely outdistance a German. I concluded that our work could be trusted to these young Yankee minds and that they should be trained in our work and that through them we would undertake to outdistance anything that has been done in Germany. That policy has worked out successfully. The young men who have collaborated with me all these years are graduates of over one hundred universities, all here in America.
>
> When at the opening of the war there was a searching of hearts, and a census, and a taking account of stock to find out who was loyal and who was to be suspected, I know you will all be pleased to hear that among all of these scientists and all of these engineers all working in the Bell System all over the United States we were not able to find one single Hun; they were all true Americans to the core.

If this is successful in Dr. Carty's case, can it not be made so in every American industry? Have we not in the past been overlooking the great genius at home for the lesser abroad?

On May 17, Theodore M. Knappen, in an article in the daily press, said: "Tomorrow the one hundredth De Haviland 'plane equipped with a Liberty motor will be shipped to France. The De Haviland Four, with its Liberty motor installed, is the fastest flying machine in the world. It can be seen daily at the field of the Dayton (Ohio) Wright Company flying circles around the Rolls-Royce in the same sort of 'plane, and the Rolls-Royce is admittedly the most powerful aërial engine that the Old World has produced." Yes, the Yanks are coming.

Our publication of the Blackstone Roll of Honor in our issue of April 23 has got us into trouble, for it has produced an avalanche of lists from other plants. It would be impossible, of course, to reproduce all of these. One of these letters from E. C. Bingham, chief engineer of the Waldorf-Astoria, contains 134 names from his department. We wish that we could print every name, not only in this but in all of the other patriotic groups.

Correspondence

Smokelessness and Fuel Saving

On page 565 in the issue of Apr. 16 are given a number of prize-winning posters designed to encourage the abatement of smoke in Pittsburgh. The poster awarded the second prize, at the top right-hand corner of the page, and, to a lesser degree, that at the bottom right-hand corner, appear to the writer to call for a little friendly criticism. While an admirable design and "eloquently practical," the top poster might appear to give a wrong impression, yet a common one. It says "20% of Coal is lost in Smoke." But this is not quite true. The losses up the stack are about 20 per cent., sometimes more, but this is not smoke, but the total losses of heat, due either to incomplete combustion on the one hand or excess air on the other and the necessary loss chargeable to draft, and so on.

Roughly speaking, the loss due to visible smoke is perhaps between 1 and 2 per cent. in carbon and hydrocarbon particles. In addition there is the loss due to carbon monoxide or combustible gases carried away unburnt, amounting perhaps to 13 per cent. (to be added to those of actual heat carried away). These are losses due to incomplete combustion. Then there is the loss due to excess air because of air infiltration, a loss usually considered as being greater than that due to incomplete combustion and deficiency of air, because with excess air, if thoroughly mixed with the gases of combustion, the stack tends to smoke less and does not attract attention, thus leading to carelessness in firing and failure to maintain the fuel bed and apparatus in good condition.

Smoke may be due to insufficient air, insufficient furnace space, insufficient furnace temperature and insufficient intermixing of air and combustible gases. Too many plants, lacking proper settings and furnace proportions, resort to excess air as the simplest method of conforming to civic smoke ordinances, and thus smoke is reduced by resorting to excess air and inefficient combustion, increasing the invisible but decreasing the visible losses up the stack. It is well known that to obtain smokelessness without on the one hand having excess oxygen and on the other hand too little, forming carbon monoxide, is difficult. In fact, one always suspects a stack that never gives off smoke at some time as indicating an inefficient plant, where the setting and furnace proportions are favorable, but where excess air is occurring. It is also often found that higher evaporation, with some settings, can be obtained with a smoking stack than without smoke, because in such cases incomplete combustion is less wasteful than excess air. Excess air is the arch enemy of efficient combustion, because, unlike smoke, it may occur unseen and persist insidiously, instead of attracting attention.

There are too many plants attempting to overcome their smoke troubles and keep within the law by using excess air. But as a rule conservation of fuel and smoke abatement go together, since accomplishment of the former must comprise the latter, while the reverse of this is not necessarily true and unfortunately, too rarely is it true. Conservation means efficiency and smokelessness. Smoke means waste and so also may smokelessness.

I believe that many, in attempting to live up to the creed of the posters mentioned, will waste coal instead of saving it. They will attempt to prevent smoke by increasing the air supply, and while reducing smoke, will lower the efficiency of combustion and thereby waste coal. Moreover, of the 20 per cent. or more loss up the stack, that actually due to visible smoke is very small.

The writer believes he is voicing the opinions of many of *Power's* readers when he suggests that the poster awarded the second prize by the Smoke and Dust Abatement League of Pittsburgh be changed to read "20 per cent. of the Coal is lost up the Stack" instead of "20 per cent. of the Coal is lost in Smoke." The reasons for the change are twofold: First, the losses up the stack due to smoke, and even resulting from sooted boiler-heating surfaces, constitute only a small portion of the total loss; second, if a fireman bases his conclusions upon the degree of smoke emitted to indicate combustion performance, while trying to eliminate smoke by excess air, a lower efficiency will be likely to follow, although the stack does give a good indication of performance under some conditions. Smoke means fuel wasted. But for the majority of plants a smokeless stack also suggests fuel wasted. A fireman who accomplishes combustion efficiency will have little worry about smoke. It seems worth while to emphasize the difference at this time and avoid anything that tends to give a wrong impression.

Chicago, Ill. R. K. LONG.

Troubles and Their Remedies in Gas-Engine Ignition Systems

Referring to Mr. Brennan's article on "Troubles and Their Remedies in Gas-Engine Ignition Systems," Feb. 19, 1918, issue of *Power*, it is hardly fair to compare high- and low-tension ignition systems without showing where each is used at its best advantage. On motors running at high speed the high-tension system has proved itself the better, but on stationary engines of large piston displacement and low speeds, low-tension ignition is used almost exclusively.

The reason for this is that the low-tension arc gives off considerable more heat than the high-tension jump spark and therefore gives a more satisfactory ignition in the large cylinder, especially where low-grade fuels are used. On low-speed engines the mechanical make-and-break igniters give practically no trouble. On engines of large piston displacement and relatively high speeds low-tension magnetos and magnetic plugs have been used quite successfully.

Canton, China. HAROLD B. WILSON

Obstruction in Steam Separator

On taking charge of a power plant, I found that there was considerable drop in steam pressure between the boiler and engine at full load. Soon afterward, the cover was removed from the steam separator, and on the boiler side and partly filling the spaces were found numerous pieces of hard-rubber valve disks that had come from the 5- and 6-in. outlet valves on the boilers at different times and had been carried along the main and finally lodged in the separator. When a disk gave out on a valve, a new one would be put on, and the idea had prevailed that the missing parts of the old disk had been reduced to small particles and found their way out of the main. When the separator was cleared, the engines operated at full load without undue drop in steam pressure. This is the first time a case of this kind has come to my notice, and it may be of interest to others.

JOHN JAMES.

Kingston, Ont., Canada.

Handy Socket Wrench

The illustration shows some easily made attachments for a socket wrench that will adapt it to a wide range of work. The piece *A* is for use with a bar, *B*

SOCKET WRENCH WITH VARIOUS ATTACHMENTS

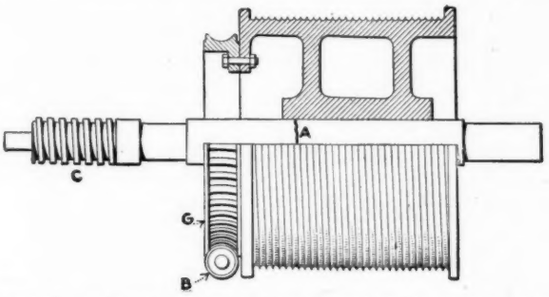
is an extension, and the tapered or drill shank *C* permits the wrench being used in an air drill, saving considerable time and labor where a large number of nuts such as on condenser heads are to be put on. The final tightening, of course, is to be done as usual.

Concord, N. H. C. H. WILLEY.

Elevator Drum Shaft Broke

It is not an uncommon occurrence for elevators, especially the older type of machines, to drop several stories without setting the safety devices. Although they may not fall fast enough to cause any very serious damage, nevertheless they come down out of control of the operator and hit the bumpers at the bottom of the hatchway.

In the figure is shown in section the hoisting drum and gear of a belt-driven elevator machine, the car of which dropped without setting the safety devices. On inspecting the machine the only defect noticeable was, the limits did not stop the car at the top floor



SECTION THROUGH DRUM, SHOWING BREAK IN SHAFT

as they did before the accident, and on the down motion the car would stop about two feet above the basement landing. This was corrected by resetting the limit on the threaded end of the drum shaft *C*.

Two hours after this accident I was called again by the mechanic, who stated that he could not get the worm of the driving shaft to mesh into the gear on the winding drum. The teeth of the gear *G* were resting on the outside edge of the thread of the worm *B*. On trying to reset the slack cable safety device, I noticed that the drum seemed to be raised up at the gear end. It was then decided to dismantle the machine and remove the drum shaft, which appeared to be either sprung or broken. When the bearing cap was removed from the gear end of the shaft, it was found that the end of the shaft could be easily moved in any direction, showing it to be broken just inside of the end of the drum, as at *A* in the figure. The machine had carried loads of 1000 to 1500 lb. with the shaft in this condition, but when sufficient weight was placed on the car the drum was lifted high enough to clear the worm. When the drum was in this position, it was rubbing on the ceiling, the friction of which acted as a brake to prevent the drum from unwinding rapidly enough to release the safety clutch on the top of the car, consequently the car went to the bottom of the hatchway before it stopped.

All elevator cars and machines should be inspected each day for any possible defects, as eternal vigilance is the price of safety. However, the foregoing is something that could not be very easily detected by an inspection.

R. A. CULTRA.

Cambridge, Mass.

Sand for Extinguishing Fires

I saw a suggestion the other day that a number of buckets filled with water and some filled with sand should be placed in a convenient place in the electric station for use in case of fire. "Buckets filled with water" doesn't look good to me, as we all know what water and electricity will do, and although careful as possible, somebody is apt to get hold of the wrong bucket, especially if he comes from outside the operating room.

D. R. HIBBS.

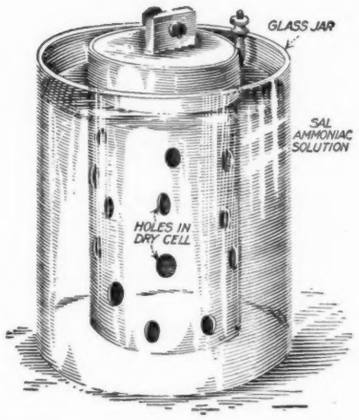
New York City.

Recharging Dry Cells

It is impossible to recharge dry-battery cells by passing an electric current through them as is done with secondary cells, because the chemical action in the cell, while in use, deteriorates and wastes the elements. Dry cells can, however, be partly recuperated by the following method, although the economy in doing this is doubtful in most cases, since new cells can be obtained more cheaply than the cost of material and time expended in recovering the old ones.

If the zinc containers of the cells are free from holes and in good condition, a sal ammoniac solution (0.25 lb. of sal ammoniac to about a quart of water) can be poured into the cell and allowed to soak into the porous compound between the carbon electrode and the zinc container, through holes bored in the asphaltum seal. When the solution has penetrated thoroughly, the cells should be resealed to prevent evaporation.

Another method, is to punch a number of holes in the zinc container and place the cell in a glass jar containing a sal ammoniac solution, using the dry cell



DRY CELL PLACED IN GLASS CONTAINER

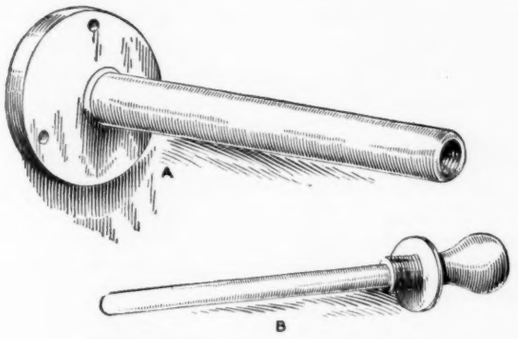
as the carbon and zinc electrodes of the so-called wet battery, as shown in the illustration. Those who have occasion to renew their wet batteries can follow out this scheme to good advantage. Old dry cells can be obtained free of charge from most garages; then all one has to do in renewing the battery is to make a new solution and place the cell in it as stated in the foregoing.

V. J. KUBANYI.

New York City.

Filing Record Charts

The subject of keeping and filing recording-instrument charts is one to which considerable discussion has been devoted. The illustration shows a convenient way to file the record sheets of various curve drawing instruments so that they are always easy of access. A piece of brass pipe small enough to slip through the hole in the center of the chart is threaded into a flange as shown and mounted on the wall, as at *A*. The outer end of the pipe is threaded on the inside to receive the movable part *B*, which is made of a small rod threaded into a bushing that can be screwed into the tapped end of the pipe. On the other end of the bushing is threaded a knob and collar. The charts can be placed on the pipe and the rod screwed into the end of it, the collar keeping the charts from coming off. When any particular record sheet is wanted, all that has to be done is to unscrew the rod and slide the charts to the right of the one wanted onto the rod as it is withdrawn, and then the desired chart can



PARTS OF CHART-FILING DEVICE

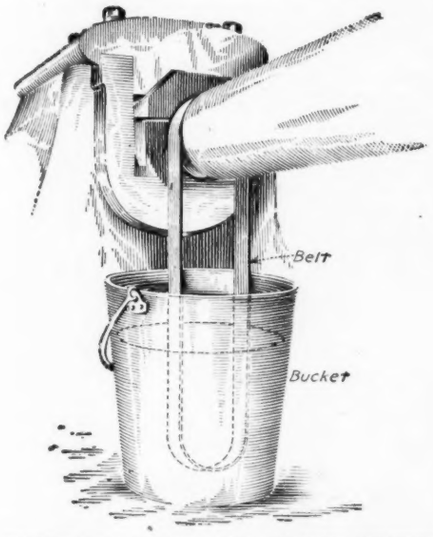
be removed and the others replaced. If it is desired to mark the place where the removed chart came from, a piece of blank cardboard the size of the chart can be used for that purpose.

W. H. NOSTAN.

Philadelphia, Penn.

Keeping Engine Bearings Cool

Some time ago a neighboring engineer had on one of his engines a bearing that ran hot no matter what ordinary measures were taken to keep it cool. As the machine could not be shut down, he tried the scheme shown in the figure with good results. A piece of old belting four or five feet long was placed around the shaft and the ends laced together. A bucket of water was then placed under the shaft and the belt allowed



ENGINE BEARING AND WATER BUCKET

to hang into it. The weight of the belt on the running shaft caused it to travel through the water and carry enough of the latter to the shaft to keep the temperature near normal. Of course water worked into the bearing, but that was better than destroying it and the water did no harm until the machine could be shut down.

W. T. BROWN.

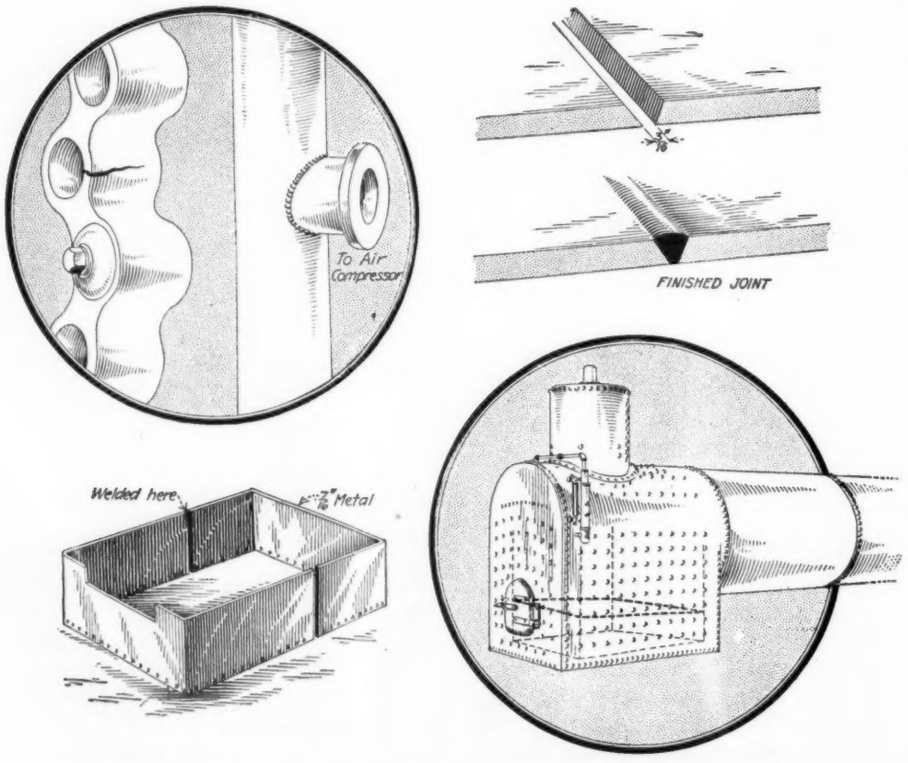
Philadelphia, Penn.

Repairs by Oxyacetylene Torch

I was interested in the way Mr. Oakley repaired the worn valve stem, as described in the issue of Feb. 12, page 230, because the same day that I received that issue I was repairing a valve stem worn in the same way, but I repaired it differently. About eight years ago I became interested in the utility of the oxyacetylene torch as part of my engine-room equipment, and it has saved me a lot of work and expense. I have done many kinds of jobs with it such as repairing broken parts of machinery and filling up worn parts, tapping steam lines, and welding cracks in steam pipes while in place.

A short time ago I put in a new air compressor that required a 4-in. steam connection, so I tapped a 5-in. pipe that was close by. I first cut a flange out of 1-in. plate with my cutting torch and welded the flange to a piece of pipe 6 in. long. Then I shut the steam off the 5-in. line and, with the torch, cut a hole in the pipe and set the 4-in. nipple into it in a straight line toward the air compressor and welded it in, doing away with a tee and two elbows. The actual welding time was an hour and a half, and a lot of labor was saved on this job. Many such jobs can be done with a welder's torch around an engine or boiler plant. About three years ago a crack developed near a handhole plate in a tube header of a B. & W. boiler, but I welded it up and have never "heard from it" since. The welding time was fifteen minutes, and the expense was trifling compared with what it would cost to take the header out and put a new one in. I would like to see brother engineers get to using the welding torch and save themselves a lot of time, labor and money. I have just finished putting in a part of a firebox in a locomotive boiler, as shown in the illustration. I have repaired three in this way, and one has been in use three years, one a year and a half and the last one about a year, and none of them has ever shown a leak although working every day. I would be pleased to see in POWER descriptions of repair jobs done by brother engineers. All that is required is practice and common sense.

Felton, Cuba. JOHN I. CRANFORD.



WORK THAT CAN BE DONE WITH THE OXYACETYLENE TORCH

Different Rate of Scale Formation

My attention was engaged by the letter by Thomas J. Pascoe in the issue of Apr. 9, page 521,* describing the scale conditions found in the boilers under his charge. The method of blowing soot from the tubes undoubtedly accounts for the different quantities of scale found in the tubes on the two sides of the boiler. Cleaning soot with the hand steam lance through the side doors would clean only part way across the boiler, and some of the soot blown from the tubes close to the dusting doors will be redeposited on the tubes on the far side, consequently, the rate of heat transmission is much higher on the side of the boiler near the dusting doors. With a uniform feed the amount of scale-forming material per gallon of water will be the same. If, however, on account of a difference in the amount of soot on the outside of the tubes, the rate of evaporation is two or three times as great in one tube as in another, the total amount of scale deposited will of course be greater.

After a certain amount of scale is deposited on the inside surface of the tubes near the dusting doors, the rate of heat transfer through different tubes across the width of the boiler will tend to equalize, because the greater resistance of the soot on the far tubes will be balanced by the greater resistance of the scale on the tubes nearest the dusting doors. The soot deposit accumulates more rapidly than the scale, however, and on account of the dead gas film surrounding the soot deposit, the insulating effect of the soot is much worse than that of the scale. For this reason the rate of steam-making and the amount of scale in the soot-covered tubes can never catch up to those that have been cleaned from soot.

I believe that if Mr. Pascoe will clean all the soot from each of his boiler tubes, he will find that the amount of scale deposited in each tube of one horizontal row will be very nearly the same across the full width of the boiler. The condition he has found is proof of inefficient soot removal by the hand steam lance by side dusting doors. CHARLES DEVED.

New York City.

*See also page 559, April 16, 1918.

Inquiries of General Interest

Cross-Sectional Area of Smoke Uptake—For a horizontal return-tubular boiler should not the smoke uptake have the same areas as the united areas of the flues? T. E.

For good results from the flues as heating surfaces, the smoke area of the flues usually is made one-seventh to one-eighth the area of the grate, but with tight connections, easy courses for the smoke and good stack draft, an uptake area one-tenth of the area of the grate will be sufficient.

Operation of Blowoff Valves in Series—What is the proper manner of operating the blowoff valves on a boiler when it is equipped with two valves in series? R. M. H.

There will be more wear and cutting of the inner valve, and it will be nearly the same whether the outer valve is opened before or after the inner valve; and as the outer valve will be least injured when wide open, in blowing off it is better to first open the outer valve fully and leave it wide open until the inner valve has been fully closed.

Rerolling of Boiler Tubes—Is there any danger of running return-tubular boilers too long without rerolling the tubes provided they have never leaked? The tubes of my boilers have been used for about four years without leaking and have not been rolled during that time. W. P. S.

If the tubes have been properly flared or beaded over at the ends, rerolling them should not be done with the purpose of increasing their hold on the tube sheets as rerolling has the effect of weakening the tube material and should be performed only for the purpose of stopping leaks. To disturb the present setting of the tubes might start leaks.

Burning Wood and Coal Together—Can boiler firing be performed economically by burning wood and coal together? C. R. F.

Much better results are to be obtained, both for fuel economy and boiler capacity, by burning the different kinds of fuel separately. When wood and coal are fired alternately, or together, the light, rapidly formed ash of the wood blankets the coal and prevents a free supply of air, requiring frequent stirring of the fuel bed, which retards progressive combustion of the coal and results in waste from dropping of unburned fuel through the grates.

Composition of Ash in Coal—What does the ash in coal consist of? W. H. L.

The ash in coal may be considered to be derived from the original vegetable material or substances deposited during the laying down of the coal bed, or subsequently. The ingredients as ash exist as a mechanical mixture of silicates, oxides and sulphates; the different percentages vary greatly, usually with predominance of the silicates, and composed largely of silica (SiO_2), oxide of aluminum (Al_2O_3), oxide of iron (FeO or Fe_2O_3), oxide of lime (CaO) and oxide of sulphur (SO_3). Smaller percentages are contained of oxide of magnesium (MgO), oxide of sodium (Na_2O) and oxide of potassium (K_2O).

Adiabatic and Isothermal Expansion and Compression—What is the difference between adiabatic expansion or compression and isothermal expansion or compression? B. H.

When a gas expands and neither receives nor parts with heat during the expansion excepting the loss of heat due to the external work performed by its expansion; or when compressed it neither receives nor parts with heat during compression, excepting the mechanical equivalent of heat received for its compression, such expansion or compression is said to be adiabatic. If a gas expands and receives during expansion the exact amount of heat that it expends in performing work, or when compressed, if it rejects the amount of heat equivalent to the mechanical energy spent upon it, and there is no other heat received or lost, the temperature remains constant and the expansion or compression is called isothermal.

Injector Will Not Feed Boiler—An injector that until recently operated all right for feeding a boiler will lift but will not discharge water to the boiler. What is suggested to remedy the trouble? S. A.

The injector should be supplied with dry steam taken from a separate connection out of the top of the boiler. If any other supply is taken out of the steam connection it is likely to reduce the pressure too much. The steam-supply and water-discharge pipes, valves and fittings should be examined and cleaned of any rust or scale. If the injector will not operate with clear connections to the boiler, it should be taken apart and cleaned of scale and carefully examined. The tubes or passages may be badly worn from cutting action of the steam or from gritty water, requiring the renewal of defective parts.

Lining Up Crankshaft from Guides—Would it be practical to line up the crankshaft of an engine by taking the line from the V-guides in the frame? J. F.

For proper working conditions, the wearing surfaces of the guides should be parallel with the cylinder center line and it would be practical to line up the crankshaft from the wearing surfaces of the guides if they are known to be in proper alignment. It is better to refer all alignments to the cylinder center line, for this always is derivable from the cylinder counterbore which is not subject to wear and bears a constant relation to the framework of the engine; besides, greater accuracy in relative alignment of different parts of an engine is obtainable by referring all adjustments in as direct a manner as possible to a single permament base-line.

Loss of Heat Value from Moisture in Coal—What would be the percentage of loss of heat due to 12 per cent. moisture in coal if the dry coal contains 13,500 B.t.u. per pound? J. W. L.

The water in the coal must be evaporated from the temperature as fired and discharged as steam superheated to the temperature of the uptake gases.

The loss in B.t.u. per pound of the moist coal would be

$$W\,[212 - t + 970.4 + 0.47\,(T - 212)],$$

in which

W = Percentage of moisture;
t = Temperature of the coal as fired;
T = Temperature of the uptake gases;
0.47 = the mean specific heat of superheated steam.

Assuming t = 60 deg. F. and T = 500 deg. F., the heat loss per pound of the moist coal due to the presence of 12 per cent. moisture would be 0.12 [212 — 60 + 970.4 + 0.47 (500 — 212)] = 150.9 B.t.u.

With 13,500 B.t.u. per lb. of dry coal and 12 per cent. of moisture, each pound of the moist coal would contain 88 per cent. of 13,500 = 11,880 B.t.u., so that the loss due to the presence of 12 per cent. of moisture would be

$$\frac{150.9 \times 100}{11{,}800} = 1.27$$

per cent. of the theoretical heat value of the moist coal. The heating value of the coal reduced to a dry coal basis would be equivalent to 11,880 — 150.9 = 11,729.1 B.t.u. per pound of the moist coal, so that the presence of 12 per cent. moisture renders the coal of

$$\frac{(13{,}500 - 11{,}729.1) \times 100}{13{,}500} = 13.1$$

per cent. less commercial value than if the coal were dry.

[Correspondents sending us inquiries should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications and for the inquiries to receive attention.—EDITOR.]

National Coöperative Convention A. A. E.

MAY 14 at the City Club, Chicago, the American Association of Engineers held its fourth annual convention. Delegates from all engineering societies in the country had been invited jointly by the Committee of Engineering Coöperation and the association, as the question of coöperation was to receive further consideration. Representatives from approximately fifty societies attended. Practically all were local associations, or chapters of the national societies. President E. T. Perkins called the convention to order and the delegates were made welcome by John Ericson, city engineer. To conserve time the convention was split up into five special sessions as follows: No. 1, under W. D. Gerber, to review return reports of a questionnaire that had been sent out to all societies; to consider how they can avoid duplication and coördinate activities, and to report on the advisability of uniform legislation for licensing engineers. Session No. 2, headed by F. R. Low, was to review publicity given the profession due to its activities in the war. No. 3, with W. H. Finley in the chair, considered the demand for and the supply of technical men for war work and the advisability of a central coöperative employment agency to prevent the tax of commissions on engineers employed for Government work. G. W. Heald headed session No. 4, which was to consider what has been done by engineers to increase the distribution and conservation of fuel. In session No. 5 Prof. R. C. Yeoman conducted the discussion on the advisability of standardizing engineering education. Summaries of the discussions in the individual sessions were reported back to the convention at the afternoon meetings.

Session No. 1 Reviews Questionnaire

The questionnaire, which session No. 1 reviewed, consisted of 24 different questions divided into five distinct groups, as follows: Society activities, war programs, employment features, education and publicity. A summary of the returns from 64 societies having a total membership of 31,500 scattered throughout all parts of the country, but not including the four big national societies, may be of interest.

The number of members in active military service averaged 15 per cent., those who still desire to enter military service, 10 per cent., and the members available for emergency government work, 50 per cent. The general opinion was that the status of the engineer will be better after the war. Only two societies are at present organized so as to give systematic service in securing employment for engineers who return from the war. Other societies will be willing to do all that they can. The present demand considerably exceeds the supply of technical men in all localities except the South. The demand is primarily for engineers in positions below that of an assistant engineer. Many war industries are suffering for want of this class of men. The individual efficiency of technical men can be raised through improved education, through individual concentration, through united societies and through more active part in public life, through mixing and through earnest coöperation. Considering the increased living expenses, the sentiment of all societies is that the technical profession is paid from 50 to 75 per cent. too low; that its members are not paid sufficient for what is expected of them when compared with what other classes of men receive. The war has reduced the amount of work for engineers in private practice for all except chemical engineers. The compensation has remained about the same.

The societies generally favor licensing engineers, especially if license laws are made uniform by Federal action and if proper investigation is made so that the law provided is just. The societies are unanimously opposed to reducing the present four-year engineering courses, as even this is inadequate training. They think that the year should be 50 weeks, and the work more concentrated, so as to reduce the time element. Special short courses are also advocated for those who desire to go into war service immediately. The majority of the societies favor standardizing engineering courses, so as to obtain uniformity throughout the country, standardization to be done only in a general way and so as not to interfere with individual specialization. The societies have had only limited success in securing publicity, that obtained being in the technical press and in a few instances in the local papers. The societies that expressed an opinion recommended coördination of society activities through some national body, but as a whole there was no consensus of opinion as to what that body shall be or how coördination shall be worked out.

Coördination of Society Activities

Discussion at the session centered in coördination of society activities. Hunter McDonald presented the Nashville plan as an answer to question 24. It was his opinion that there were at least 200,000 engineers in the country and only about 30,000 were enrolled in the four big national engineering societies. The plan of procedure, having nine subdivisions, follows: (1) Determine what shall constitute an engineer. (2) Take a census of these in each state. (3) Perfect organizations in each state on a common constitution. (4) Determine upon an equitable representation of each state organization. (5) Arrange a central government of delegates in coöperation with the Engineering Council, delegated representatives to have a majority vote. (6) Local organizations to continue autonomous, but to become a working part of state organizations upon a basis to be worked out. (7) All local organizations in any one locality to be combined. (8) National societies to retain their organization and autonomy for technical purposes only, surrendering all other activities to the central body. (9) All other organizations intermediate between the national or central body and the membership or state organization to be disbanded.

A second plan to bring about close unity and fellowship among engineers in each community was presented by C. A. Drayer, of Cleveland. It had been prepared by the administrative committee of the Committee on Coöperation, and while professedly incomplete, owing to lack of uniformity in dues and standards of membership, it was offered as a model that might be expanded to suit conditions. Some of the organization principles in the intersociety relation problems were enumerated as follows:

Existing organizations shall be encouraged to study their own efficiency, shall be strengthened by all possible aid and no new ones created in fields already occupied.

Work shall be divided among existing organizations so there shall be no duplications or waste of effort.

Existing organizations shall be closely knit together by a workable relation capable of vigorous growth and usefulness to the profession and to the public.

Within the community unity shall be brought about as in National and state governments by each engineer belonging to the local society rather than by affiliation of local chapters or sections of the national societies with one another or with the local society. This is the essentially American ideal.

The first principle shall be the good of the whole.

Joint Memberships

It was recommended that arrangements be made between any two societies that members in either society at the time the agreement is made may be admitted to the proper grade of the other society without further payment of initiation fees and without further payment of dues until the time has expired for which dues have been paid to either society, but not to exceed one year. Thereafter one initiation fee shall admit an applicant to the local society and one national society, provided he make application to both at one time and is eligible by professional qualifications; and thereafter dues in amount agreed upon by the parties to the agreement, but less than the sum of the separate dues, shall be paid to the local society, which will remit the agreed part to the national society. When any member within the jurisdiction of the local society has joined only one society after the conclusion of the arrangement and desires to take out joint membership, there shall be favorable ar-

rangements for him to do so, but such arrangements shall be less favorable than in either of the situations mentioned.

Reference was made to the coördination that had been effected already in Ohio and Minnesota.

In a paper on the same topic presented at the afternoon session, Major Gardner S. Williams considered ideal an organization by states or districts from which members of a central council would be selected or elected and by this central council an executive board be chosen with authority to act and to direct the energies of the whole membership. This is virtually the organization of the Engineering Council, except that its authority is not clearly established. So far as a representative body for the 30,000 members of the four great national societies is concerned, the delegation of authority would meet the case, but it was questionable that it would fill the needs of the much greater number who were today outside of these national societies.

Major Williams considered it desirable to persuade the Engineering Council to provide for a general organization, to have them invite the several strong local or state societies to send delegates and with its aid to build up in every state in the Union an effective organization of the engineers therein.

It was the latter counsel that prevailed. The convention voted that a committee be appointed to confer with the Engineering Council and work out a plan satisfactory to all concerned. The discussion on licensing engineers was postponed, as there was not sufficient time to do justice to a question of so much importance. It was placed in the hands of a committee to investigate and report at the next convention.

Discussion at the Other Sessions

At session No. 2 the discussion turned to the backwardness of the engineer in public life and his undue modesty in not claiming the credit due the profession for the great engineering achievements in war and civil work. It was a defect that must be remedied if the engineering profession ever expected to take its place in the sun.

Session No. 3 brought in a resolution to the effect that the matter of fees being paid to private employment agencies for employment by the Government be brought to the attention of the proper authorities in Washington to the end that the practice be discontinued and the service be obtained from the Public Service Reserve.

A summary of the discussion at session No. 4 follows: To increase the distribution of fuel, the Fuel Administration has divided the United States into zones in order to eliminate long hauls and increase the useful service of coal cars. Industries have also been graded in order that those most essential in the conduct of the war shall have preference in order of their importance. Engineers should use and encourage others to use as far as possible coal produced nearest the point of consumption. It was also recommended that engineers wherever possible urge the prompt unloading of coal cars within twenty-four hours as ordered by the Fuel Administration. Violations of this order should be reported to the nearest local representative of the Fuel Board. Industries were urged to maintain a storage supply of at least sixty days.

To increase the conservation of fuel, engineers should become familiar with and encourage the use of bonus systems. Domestic users should be reminded to heat only such rooms as are absolutely needed, to 70 deg. or less and humidify as much as possible. Fire lightly and often, half of the fire bed at a time, when burning bituminous coal. Sift the ashes and recover the unburned coal if anthracite is burned. Watch the draft. Industrial users should be reminded that steam leaks are fuel leaks, so also are radiation losses. Both are preventable and should be reduced to a minimum. Where heating is done by steam, make the steam first do work. The power developed is a byproduct and the engine or turbine is a reducing valve. Make full use of the exhaust steam. It was the belief of the delegation that the greatest possible conservation of fuel could and should be acomplished by the carbonization of bituminous coal in byproduct coke ovens in conjunction with electric power generating plants, using the resultant coke and gas in place of coal as fuel and recovering the valuable byproducts, which are wasted when the combustion of coal takes place. Coke plants should be located at the mine where feasible.

It was suggested that all legal holidays, national or local, be observed on the nearest Monday, if said holiday should fall on any other day except Sunday. This would avoid a double stop and start each week should a holiday occur in the middle of the week.

Session No. 5 on standardizing engineering education, suggested the appointment of a committee, supplied with funds, to make up a detailed questionnaire to be sent to all societies, schools and individuals who were interested, the results to be analyzed and reported at the next convention. A resolution to this effect was laid on the table.

In the discussion following, the proposed American Academy of Engineers was subjected to severe criticism. It was considered undemocratic and not representative. Self-creation and self-perpetuation were the main objections. Before making the criticism official, a referendum, stating both sides of the question fairly, was ordered by the convention.

Realizing that the time is ripe for an inspiring code of ethics that would be a credit to the engineering profession, Isham Randolph was asked to prepare one and present it at the next convention. Other matters of importance acted upon at the afternoon session were a resolution favoring universal military training and a telegram to Director-General McAdoo to the effect that railway technical engineers did not think it just to base the wage increase on the rate of 1915. They favored the 1918 rate as a basis, and even then it would not compensate for the increase in living expenses.

The Evening Meeting

A dinner meeting in the evening was the last session of the convention. Isham Randolph, who was toastmaster, first called upon E. T. Perkins, retiring president. The work of the association during the past year was reviewed briefly. The rapid growth was gratifying. Several new chapters had been organized and every month 100 new members had been added. Service was the watchword of the association and was the secret of its success.

Samuel Insull delivered a most interesting and instructive address on Illinois War Work. Mr. Insull is chairman of the State Council of Defense of Illinois, which has made such an enviable record in organizing and carrying on the work made necessary by the war.

James A. Davis, chairman of Speakers Bureau, National War Savings Committee, spoke on the topic "Financing the War." To show the necessity of winning the war he enumerated in detail the natural resources in the conquered territory now in the possession of Germany, the great population that would be under her control and the possibilities of the future with these resources back of her. The financial status of this country was reviewed, and the great possibilities of savings were emphasized. An army of savers must stand back of the men at the front, and with their contributions this country could spend 30 to 35 billion dollars per annum for twenty years and be no poorer than today.

Alfred D. Flinn, secretary of the Engineering Council, reviewed the efforts to draw together the four large national associations and the present activities of the body he represented, its aim being "the engineering profession united to serve America."

Following, representatives from various chapters located in Indiana, Wisconsin, Minnesota, Virginia, Georgia, Pennsylvania, Texas, Oklahoma and even as far west as California, spoke briefly. All showed enthusiasm and interest in the organization, which if properly directed should result in great things for the association.

Officers for the ensuing year were announced as follows: W. H. Finley, president; H. W. Clausen, first vice president; G. F. Vivian, C. A. Gaensslen and J. T. Mullin, national auditing committee; Harold Almert, F. K. Bennett, T. M. Chapman, J. N. Hatch, Alexander Potter and J. H. Prior, directors.

When wood alcohol is to be used to any extent, have the room very well ventilated, as it affects the eyes and even produces blindness.—*Marine Engineering.*

Colonel Carty Receives Edison Medal

Dr. John J. Carty, Colonel in the United States Army Signal Corps and Chief Engineer of the American Telephone and Telegraph Company, has been awarded the Edison Medal in recognition of his meritorious achievements in the science and art of telephone engineering.

The medal was presented on Friday evening, May 17, at the annual meeting of the American Institute of Electrical Engineers in the Engineering Societies Building in West 39th St., New York. Colonel Carty is the eighth American scientist to be honored in this way, the others being Elihu Thomson, Frank J. Sprague, George Westinghouse, William Stanley, Charles F. Brush, Alexander Graham Bell and Nikola Tesla.

A statement of the history and significance of the medal was made by Dr. A. E. Kennelly, professor of electrical engineering at Harvard University and Massachusetts Institute of Technology, who was chairman of the Institute's 1917 Edison Medal Committee. Dr. Michael I. Pupin, of Columbia University, told of the work of Colonel Carty, the foremost telephone engineer in the world. The medal was delivered by the president of the Institute, E. W. Rice, Jr., also a scientist of note, who is president of the General Electric Company.

The Edison gold medal was founded in 1904 by the Edison Medal Association, an organization composed of old associates and friends of Thomas A. Edison. It is awarded annually by a committee of 24 members of the American Institute of Electrical Engineers, the first recipient being Elihu Thomson in 1909.

President Rice said in part:

More than any other man, Colonel Carty is responsible for the development of telephone engineering as it is known today, and it is peculiarly fitting that he should receive this new honor at a time when he is working day and night to promote the best military use of mediums of communication which have been developed largely through his efforts in time of peace for the advancement of the nation's social, commercial and industrial activities.

Colonel Carty is well known as the engineer of the great transcontinental telephone line, the longest in the world, and as the engineer who made possible wireless telephoning over distances up to 5000 miles.

He entered the telephone business when it was in its infancy, and it would be difficult to find a phase of its development which does not bear some imprint of his genius. His technical achievements are so numerous as to prevent full recounting. He first pointed out the correct theory of induction between telephone circuits, showing how to obtain a balanced metallic circuit and devising methods for correctly transposing phantom telephone circuits. That was in 1887.

In 1888 he developed the bridging bell and pointed out the importance of the bridging principle of telephone construction in obtaining efficient operation of telephone systems and in constructing balanced metallic circuits. In 1889 he invented the principle of the best and most generally used common battery system, by which a number of telephone instruments may be simultaneously operated from a single central battery. During this period he also devised important improvements pertaining to switchboard circuits having to do with the busy test feature and the connecting in of operators' instruments.

In 1912 the telephone engineering force built up and directed by Colonel Carty had so far overcome the difficulties in the way of underground telephony as to make possible all-underground talking between New York and Washington, and by 1913 they had extended the range of underground telephony to connect Washington and Boston.

The year 1914 witnessed the fruition of the efforts of these engineers to bring transcontinental telephony into existence, and in 1915 Colonel Carty was able to present to the world important developments in wireless telephony, which made possible the hurling of words through space across the American continent from Washington to Mare Island, California, from Washington to Hawaii, 4900 miles distant, and from Washington to Paris, bringing Europe and America into speaking distance of each other for the first time.

Then came the threat of war with Germany, and in 1916 Colonel Carty coöperated with the Signal Corps of the Army and with the various departments of the Navy in making arrangements which would insure the readiness of the Bell Telephone System for military service in case this country did become involved in the great conflict. In 1917 these plans were put into active use with a marvelous degree of success.

Colonel Carty's technical telephone achievements alone would entitle him to his preëminent position in his field, but he also occupies an equally high place in the regard of scientists because of the character of his work in directing, developing and coördinating telephone engineering.

He has always insisted upon the importance of determining the requirements of the service before undertaking to develop specific ideas. He has always emphasized the necessity for getting the full set of facts in each case and of studying the effects of growth so that a new device may not only be satisfactory at the start, but may fit into the system as it develops. The several hundred engineers engaged by the Bell System in conducting researches, testify to the value which Colonel Carty places upon this phase of telephone work, just as they do the emphasis he puts upon the importance of keeping bad devices and methods out of the telephone plant. Colonel Carty is known also for his marked ability to make friends with and inspire confidence in those with whom he comes into contact, so that his name is one to conjure by among those for whom he works, those with whom he works and those who work for him.

Dr. Pupin said:

Carty's life is filled with romance. He never went to college. At the age of 18 when other boys entered college he entered the service of the American Bell Telephone Co. and at the age of 25 became chief engineer of the great New York Telephone Co. He started without getting honors, titles, and now he is a doctor I do not know how many times and on the top of these titles colonel of the United States Army. If General Pershing has his way Carty will be a general before many a day. General Pershing understands that Carty is made of stuff of which great generals are made.

Colonel Carty in his speech of acceptance gave credit for the American Telephone achievements to the engineers who have been associated with him in the Bell System and paid a tribute to Maj. Gen. George O. Squier, chief signal officer of the United States Army for his work in planning before the United States entered the war for the rapid mobilization of telephone wires and telephone men for Signal Corps work. Referring to the Bell System engineers, Colonel Carty said:

We hear a great deal about the German scientist and the wonderful things he has done and has been planning. Many years ago, when German "Kultur" was interpreted by many to mean German culture, it was suggested to me that we should send to Germany to get some of the Herr doctors to teach us the high science. I always opposed that, believing that the Yankee mind, the Yankee boy, when his attention was turned to scientific problems would surely outdistance a German. I concluded that our work could be trusted to these young Yankee minds and that they should be trained in our work and that through them we would undertake to outdistance anything that has been done in Germany. That policy has worked out successfully. The young men who have collaborated with me all these years are graduates of over one hundred universities all here in America.

When at the opening of the war there was a searching of hearts and a census and a taking account of stock to find out who was loyal and who was to be suspected, I know you will all be pleased to hear that among all of these scientists and all of these engineers all working in the Bell System all over the United States we were not able to find one single Hun; they were all true Americans to the core.

Cottonseed Oil Cake as Fuel in Egypt

The high price of coal and the shortage of ocean freight space have produced a condition in Egypt under which cottonseed oil cake is being used as a substitute for coal as fuel, according to *Commerce Reports*. The high price of coal induced experiments with oil cake. The relation of the calorific value of cake to coal was found to be 1¾ tons of cake to 1 ton of north country large coal.

The present price of coal in Egypt is about $80 per ton. The price of oil cake at various times during the last two years ranging between $32.50 per ton and the present price of $15. Cake is now being largely used in place of coal in boiler plants, in hotels, restaurants, and private houses. One large concern saves two men per boiler in burning cake instead of coal. Cake ash has a value as fertilizer of about $25 per ton.

"Coal Week" from June 3 to 8

Coal week, the period from June 3 to 8, has been selected by United States Fuel Administrator Garfield for an intensive and specific drive on the early ordering of coal. The fuel organizations of the various states, the county chairmen of fuel committees throughout the nation, coal dealers, chambers of commerce, mine operators and others are all called upon to do their utmost to make this week's drive a big success.

From some states has come the objection that the trouble about the coal supply does not come from the consumers, industrial or domestic, but from the dealers, who complain that they can not get sufficient coal to deliver. In spite of this, the Fuel Administration is anxious that the early ordering campaign be vigorously pushed.

By accumulating a large volume of orders in the hands of the dealers it is expected that there will be demonstrated to every agency concerned in the distribution of coal the universality and urgency of the demand and this, in turn, will give rise to a steady and increasing pressure for rapid and equitable distribution. This is particularly true as to the railroads and other transportation agencies. Every unfilled order for coal will at once become an active and pressing argument for increased distribution efficiency. By keeping coal orders constantly accumulating, the resulting pressure, it is believed, will have the effect of maintaining production at the highest possible point during the summer months.

It is also felt that with the bulk of the year's supply of coal ordered well in advance, the various distribution agencies of the Government will be in a position equitably and properly to adjust the demands as between different communities. It will be possible accurately to gage the increased demand and properly to divide the available supply.

It is pointed out that it is obvious that the entire coal output of the country cannot all be delivered at once; but at the same time it is clear that no matter what the condition of the supply may be those orders that are on the books of the dealers will be filled prior to those received later in the year.

The state branches of the National Council of Defense are being asked to aid in this "early-ordering" drive, and the Fuel Administration believes that if the bulk of orders, both domestic and industrial, are in hand by July 1 there will result a marked improvement in railroad facilities, especially as by that time millions of dollars' worth of the new equipment ordered by the Director General of Railroads will have come into use.

While particular pains are to be taken in this campaign to reach the domestic consumer in an effort to ward off any possible coal shortage in the homes next winter, it is plain that, after all, the greatest help toward the plans of the United States Fuel Administration must come from the large industrial consumers who, by getting in early their orders for the bulk of the fuel their plants will need, can lend a tremendous impetus toward speeding up production at the mines and delivery that shall employ to the fullest all transportation facilities.

Although the "early ordering" campaign has practically only begun, its effects are already being felt in increased production. The week ending Apr. 27 showed, according to the reports of the United States Geological Survey, a total production of 11,668,000 net tons, an increase of 5.7 per cent. over the preceding week. The average production per working day was 1,946,000 net tons, compared with 1,840,000 net tons the week previous and 1,680,000 net tons during April, 1917.

The week ending Apr. 27 recorded not only the highest rate of production for the past 12 months, but was the third successive week of rising production.

There was also a gradual improvement in car service conditions in the mines during the week ending Apr. 20. Loss of production due to car shortage throughout the entire country was 16.2 per cent. as against 18.1 per cent. in the preceding week. The loss due to labor shortage was 4.8 per cent., as against 3.8 per cent. in the preceding week.

The reports showed an improvement in the demand for coal, due to the coöperation of coal consumers with the Fuel Administration's campaign for early ordering. The loss of production due to "no market" in the week ended Apr. 20 was only 1.8 per cent., for the country as a whole, as against 2.8 per cent. in the preceding week.

The loss due to "no market," however, is still large in the states west of the Mississippi River, where summer production must be maintained if the consumers are to avoid a serious coal shortage next winter. The mines in these states have ample capacity to care for the consuming territory allotted them under the zone system of distribution, but these mines must be kept at work at maximum capacity throughout the year in order to provide a proper supply.

The mines of Kansas and Missouri showed a loss of production of 7.5 per cent. due to lack of demand. Those of Oklahoma and Arkansas showed a falling off of 9.3 per cent. due to the same cause. Iowa mines lost 30.7 per cent. of their production because buyers were not available, the Pacific Coast States showed a loss of 5.8 per cent. due to this cause, and the Rocky Mountain States a loss of 12.3 per cent.

While all these figures showed an improvement as compared with previous weeks, the Fuel Administration will make a determined effort to eliminate all loss of production due to lack of market.

Richmond, Va., To Save Electric Current

The Fuel Administrator of the City of Richmond, Va., has requested the city to sell its surplus electric energy to the Virginia Railway and Power Co. If this idea is carried out, it will save a matter of 6000 tons of coal annually.

Fuel Administrator Byrd states that an investigation by electrical experts disclosed that 4,000,000 kw.-hr. of power generated by water without cost by the electric plant owned by the City of Richmond is not being utilized and is being permitted to go to waste. The commercial sale of this power is prohibited under an existing city ordinance. The sale of this surplus power to the Virginia Railway and Power Co. will enable the release of an estimated quantity of from 5000 to 6000 tons of coal annually. The City of Richmond will benefit by receiving the fair market prices of the power for which they are not now receiving any return.

Before the intercommunication is established between the municipal electric plant and the power house of the Virginia Railway and Power Co., an ordinance must be passed permitting the city to buy and sell electricity. After the passage of the ordinance the administrative board would determine whether the city desired to sell its surplus current, and whether it would sell to the Virginia Railway and Power Co., or to some other consumer. The request of the Fuel Administration is taken in certain quarters to mean the initial step toward the conservation of coal, and if such action is necessary the administration will direct that the surplus current be sold to the commercial company. There exists at the municipal plant from time to time surplus water power which, under present conditions, goes to waste. By connecting the two systems all surplus energy generated by the water power station of the city plant would be thrown into the feed main of the Virginia Railway and Power Co., and would thereby enable a corresponding reduction in fuel consumption at the steam plant of the traction company. Through this interconnection there would be added to the power supply of the city a needed surplus.

If this proposition is carried through, it will create a valuable precedent for many similar cases throughout that section of the country.

It is understood that the intercommunication between the two plants would exist only for the duration of the war, and the individuality of the power houses would in no way be disturbed. The Fuel Administration suggests that a Board of Arbitration be formed to adopt a fair rate at which the surplus electricity will be sold to the traction company, and offers to place priority orders for all equipment needed to effect the connection. It is estimated that the revenue to the city would be about $40,000 per year.

Students To Have Military Standing

To provide military instructions for the college students of the country during the present emergency, a comprehensive plan will be put into effect by the War Department, beginning with the next college year, September, 1918. The details remain to be worked out, but in general the plan will be as follows:

Military instruction under officers and noncommissioned officers of the Army will be provided in every institution of college grade which enrolls for the instruction 100 or more able-bodied students over the age of 18. The necessary military equipment will, so far as possible, be provided by the Government. There will be created a military training unit in each institution. Enlistment will be purely voluntarily, but all students over the age of 18 will be encouraged to enlist. The enlistment will constitute the student a member of the Army of the United States subject to active duty at the call of the President. It will, however, be the policy of the Government not to call the members of the training units to active service until they have reached the age 21, unless urgent military necessity compels an earlier call. Students under 18, and therefore not obliged to enlist, will be encouraged to enroll in the training units. Provision will be made for coördinating the Reserve Officers Training Corps system, which exists in about one-third of the collegiate institutions, with its broader plan.

This policy will accomplish a twofold object: First, to develop as a great military asset the large body of young men in the colleges; and second, to prevent unnecessary and wasteful depletion of the colleges through indiscriminate volunteering by offering to the students a definite and immediate military status.

High-Grade Men Wanted for Army Ordnance

An urgent call for high-grade technical men and operatives to fill war positions in industrial establishments was made May 13, through the Civil Service, by the United States Army Ordnance. Salaries ranging from $1600 to $6000 a year will be paid the men who qualify for the places.

Chemists and chemical engineers, men experienced in the manufacture of gas, mechanical engineers on high-pressure apparatus, engineers to take charge of power houses and foremen of machine shops are needed. Persons of military age accepting appointment will not avoid the obligations of the Selective Service Law.

No applications will be accepted from Government employees or employees of firms or corporations engaged in contracts for the Government or its Allies unless written assent to such application is given by the head of the establishment that might be seriously handicapped in its war work by the loss of the man.

Salaries ranging from $1600 to $2400 will be paid junior mechanical engineers on high-pressure apparatus. Experience in the operation and control of high-pressure hydraulic and gas machinery is necessary. At least one year of such experience will be required of graduates in mechanical-engineering courses from recognized colleges. Four years' experience is required of high-school graduates.

Power-house engineers will be paid $1800 to $2400 a year while working for the Ordnance Department. Supervision of operation of water-tube boilers, condensers, pumps, steam turbines and alternating- and direct-current generators and motors are among the duties of these men. Machine-shop foremen with salaries from $1800 to $2400 also are wanted. Ten years' experience as machinists, three years in a responsible supervisory capacity, is required.

Assistant operatives in the manufacture of water gas and producer gas, mechanics experienced on high-power apparatus, and operatives of acid and chemical apparatus are needed. Many positions are open. The needs of the service are so imperative that applications will be received indefinitely. Further information is obtainable of the Civilian Personnel Section, U. S. Army Ordnance, 1330 F St., Washington, D. C.

Women for the Drafting Room

In response to an appeal from the Government to help find engineering designers and draftsmen, Dean M. E. Cooley, of the University of Michigan, has suggested the plan of fitting women for tracers and as inspectors of materials. This would relieve men for the more important duties of draftsmen and designers and help fill places made vacant by the draft. Inquiries among engineers developed the fact that those who had employed women in such capacities were enthusiastic. They were particularly neat in their work, accurate and dependable. Due to shortage of help, other engineers were anxious to give them a trial. As a result, the University of Michigan has arranged as a war-time measure a summer course to prepare women for this new work. Similar action might well be taken by other engineering colleges of the country, and it should be to the interest of engineers to support the movement and help it along by employing the girls when they have received their training. In this connection the following resolution, passed at a joint meeting of the Detroit Engineering Society and the Detroit Section of the American Society of Mechanical Engineers, shows that the possibilities of employing women in the drafting room and allied work are appreciated, and that there is the desire to allow them to give direct help in winning the war:

Whereas, The demands of the country for men and means to fight the war have resulted in a deficiency of skilled workers in the trades and professions; and

Whereas, The women of this country could with a short period of training fit themselves to fill these positions, as women have done in other countries at war; and

Whereas, Among the things that women could do advantageously are drafting and tracing, inspection and testing of materials, both physically and chemically; therefore be it

Resolved, That the universities, colleges and technical schools throughout the land be asked to consider the question of meeting this demand by providing special courses of instruction open to women students qualified to pursue such courses; and further

Resolved, That employers who could use such skilled help exert their influence with their universities, colleges and technical schools, and coöperate with them in developing and making available a great body of intelligent and adaptable women who are as eager and willing to serve their country as their brothers; thereby bringing about not only increased effectiveness in fighting the war, but also a greater mutual respect and saner relationship of our men and women.

Control of Ice

New York State Senate Bill No. 605, an amendment, approved by the Governor and now law, states the following, in part:

The ice comptroller is hereby given power to regulate and control the manufacture of artificial ice in the City of New York, on Long Island, or in the counties bordering on the Hudson River, up to and including the Counties of Albany and Rensselaer; to regulate and control the storage and transportation of natural and artificial ice in said locality; and to regulate and control the sale, delivery and distribution of natural and artificial ice in any city having more than one million inhabitants. A person, partnership or corporation shall not manufacture artificial ice, for sale or any other purpose, in the City of New York, on Long Island or in the counties bordering on the Hudson River up to and including the Counties of Albany and Rensselaer, nor shall a person, partnership or corporation engage in the business of selling and delivering or distributing artificial or natural ice in any city having more than one million inhabitants after Mar. 1, 1918, or before Feb. 1, 1918, without first obtaining a license to be issued by the ice comptroller in a form and upon terms and conditions to be prescribed by him.

Heavy penalties are provided for violation of this law.

Area and surface are not synonymous, and sometimes men mix them up as did the man who corrugated a piston, thinking that in so doing he was increasing area and making his engine more powerful.—*Marine Engineering.*

West Virginia Water-Power Legislation

It seems highly probable that there will be water-power legislation at the next session of the West Virginia legislature which will convene in January, 1919. During the special session of May, 1917, the Senate adopted a resolution requesting Governor Cornwell to appoint a committee of three to investigate the water-power situation and to submit a report to the next legislature, with such recommendations as to future legislation to encourage development as the committee might deem necessary. The governor appointed as members of that committee the Hon. Wells Goodykoontz, president of the Senate, and Senators Fred L. Fox, of Sutton, and C. C. Coalter, of Hinton. Recently that committee held its first meeting but went no farther than to make arrangements to study the present laws and to take up at a later date the drafting of new water-power statutes.

It is generally conceded that the present water-power laws of the state are prohibitory so far as any development is concerned. This has been fully attested to by the fact that since the present statutes were enacted in 1915 there has been no water-power development except on a very limited scale, although there are in the state many streams that will furnish all the power needed for years to come. Owing to present conditions, therefore, a valuable resource is not being utilized and is in fact being allowed to go to waste. As this is a time when every resource and every ounce of energy must be utilized, sentiment for legislation which will encourage water-power development and yet fully protect the rights of the state is pronounced, especially in the New River and other sections where water power is available and only needs to be harnessed.

Thrift Stamp Day a Huge Success

Thrift Stamp Day in the United States has come to stay. The results of the first Thrift Stamp Day, May 6, were so satisfactory that the National War Savings Committee of Greater New York has decided to hereafter set aside every first day of each month as Thrift Stamp Day, and all business houses throughout the Greater City have been asked to coöperate and make a special drive to boost the sales of Thrift and War Savings Stamps on those days. The results of the first big Thrift Stamp Day has convinced the workers and the managers in charge of the drive that the setting aside of one day each month for a War Savings offensive would be a splendid idea.

The question of setting aside the first day of each month for Thrift Stamp Day was broached to the leading business men of the city, and they all received the idea with great enthusiasm. Special literature has been prepared for the occasion, and the thirty-odd thousand authorized agents of the Treasury Department have been asked to do at least as well on future Thrift Stamp days as they did on the first day.

New Publications

ESSENTIALS OF DRAFTING. By Carl L. Svensen. Published by D. Van Nostrand Co., New York. Cloth, 200 pages; 6 x 9 in.; 450 illustrations. Price, $1.50.

As a book prepared especially for the evening technical school it seems to be well suited for that purpose. The treatment of the various subjects is somewhat brief, as it is expected that personal instruction is also to be given. It is therefore not a strictly "self-instruction" book, but a guide for both student and instructor.

HANDBOOK ON PIPING. By Carl L. Svensen. Published by D. Van Nostrand Co., New York. Cloth, 359 pages; 6 x 9 in.; 359 illustrations and 8 folding plates. Price, $3.

An orderly presentation of the subject beginning with a short introductory chapter of ten pages, giving an insight into the history and manufacture of pipe, followed by six others treating of "dimensions and strength of pipe, pipe threads, pipe fittings, pipe joints, standard valves and special valves." Chapters 8 to 15 deal with piping systems under the following heads: Steam piping, drip and blowoff piping, exhaust piping and condensers, feed-water heaters, piping for heating systems, water and hydraulic piping, compressed air, gas and oil piping, erection, workmanship and miscellaneous. Chapter 16 is on piping insulation, Chapter 17 on piping drawings, and the closing chapter—specifications—contains the Stone & Webster standard piping specifications and a model specification by the Walworth Manufacturing Co. The eight folding plates referred to are reproductions of the piping drawings, by Stone & Webster, for the Cannon Street Station of the New Bedford (Mass.) Gas and Edison Light Co. While this book is frankly a compilation of information and tables considered standard and the illustrations are mainly from manufacturers' catalogs, it contains much information that, when brought together in this manner, is readily accessible when needed by the engineer or student.

Personals

Edw. A. Cordes has tendered his resignation to take effect July 1, as master mechanic for the Babcock & Wilcox Co., at Barberton, Ohio. He will locate in Chicago, Ill.

H. D. Wright, who has been manager of the San Francisco office of the Brown Hoisting Machinery Co., has been appointed Pacific Coast representative, succeeding the Colby Engineering Co. in the northwest territory.

Engineering Affairs

The Society for the Promotion of Engineering Education will hold its twenty-sixth annual meeting at the Northwestern University, Evanston, Ill., June 26-29. The subject of discussion will be "The Engineering School and the War."

The Iowa Section of the National Electric Light Association will hold its convention May 31 and June 1, at Des Moines. The subjects to be discussed are as follows: The Labor Situation, by T. Crawford, Clinton, Iowa; Isolated Plants, by Austin Burton, Waterloo, Iowa; Rate Increase, by F. A. Warfield, Peoria, Ill.; The Coal Situation, by F. W. Linebaugh, Boone, Iowa; Boiler-Room Economy, by E. S. Hight, Peoria, Ill.

Miscellaneous News

A Furnace Boiler Exploded in the basement of the Russell House, Montreal, Canada, on May 11, injuring five persons who happened to be in or near the hotel at the time. It is said the explosion was caused by someone having turned off the water from the furnace.

The First Commercial Shipment of coal from the mine operated by the Alaskan Engineering Commission was made in the last week of April. A consignment of 100 tons from the Chickaloon field went to Seattle, Wash., on the steamship "Alameda." The coal was shipped in sacks under a freight rate of $5 per ton for shipments of 100 tons or more and $7.50 per ton on shipments less than 100 tons.

A Wire from Folsom to the Washington State Fuel Administrator, dated May 10, announces that "We are advised that a large number of tankers are to be withdrawn from the Pacific Ocean for Atlantic service within six months. This will necessitate changing of Northwestern industries to coal wherever possible, regardless of cost." It is understood that oil consumers in the Northwest who cannot change to coal will be required to submit by June 10 a statement giving the nature of their business and reasons for not making the change.

The City of Pasadena and the Southern California Edison Co. have filed a joint application with the California Railroad Commission asking for permission to lease the company's distributing system to the city for two years with an option of purchase. The city is to pay rental on a basis of 8 per cent. on the valuation of $513,102, with an additional rental for extensions made after Dec. 31, 1918. Under the terms of the lease the city is to purchase power from the company for a price ranging from 0.0095c. per kw.-hr. for the first 250,000 kw.-hr. to 0.0075c. for all over 750,000 kw.-hr. Pasadena agrees to lease all of its lines and distributing system outside of the city for a rental basis of 8 per cent. on a valuation of $27,928.

At the Del Monte Convention a letter from the Pacific Coast Petroleum Administrator, D. M. Folsom, was read, which stated that even with the most careful economies, the oil stored on the Pacific Coast will be exhausted within a year and the curtailment of consumption may be expected within six months or less. There has been a decline in drilling operations thus far this year of 40 per cent. as compared to last year. All fuel-oil consumers will probably be classified and only those entitled to priority rating will be supplied with oil. In the case of companies which use oil for generating power, the oil supply will be continued only if consumers served are entitled to priority rating and the burden of proof that consumers are entitled to such rating will rest upon the power companies.

Cleveland Plants Interconnected — An agreement recently made between the Cleveland Municipal Light plant and the Cleveland Electric Illuminating Co., through the National Council of Defense, will result in the interchange of power output between the two stations. An overhead connection is to be built immediately between the East 53rd Street Municipal plant and the Cleveland Illuminating Co. at East 72nd St. to provide interchange of power in case either plant breaks down. This practically guarantees war plants against stoppage of work through accident. The connection will cost $90,000. It will be financed by the Council of National Defense. Government officials agree to speedy delivery of the city's new 10,000-kw. generator, so that it will be ready to increase the municipal plant's current by fall instead of by Jan. 1.

The U. S. Circuit Court of Appeals recently reversed the decision of a lower court in the famous Elk Hills suit between the Southern Pacific and the Government on the ownership of California oil fields. In discussing this, Paul Shoup, president of the Pacific Electric Railway Co., Los Angeles, who has recently been at Washington, said that a compromise on the suit for the duration of the war is to be forthcoming very soon and that these lands which have so long been tied up in litigation will probably be opened up and developed at an early date in the most expeditious manner. Nevertheless drastic measures in curtailing the consumption of oil will doubtless be put into effect. Embargoes and restrictions of oil shipments and oil consumption generally may be expected.

NEW CONSTRUCTION

Proposed Work

N. H., Derry—The Derry Electric Light Co. plans to extend its electric transmission line from here to East Derry. D. F. Griffith, Supt.

Mass., Boston—The Board of Education will soon award the contract for the installation of a direct radiation system in the public and high school. Estimated cost, $20,000. J. J. Mahar, City Hall Annex, Consulting Engr.

Mass., Brookline—The Town is in the market for equipment for its incinerator including a steel apron conveyor complete with steel chute, motor and connections, 2 paper baling presses with motors and connections, etc. A. Varney, Engr.

N. Y., Buffalo—Cousins & Co., 74 Wabash St. will soon award the contract for the erection of a 1 story, 95 x 125 ft., reinforced concrete steel and brick boiler plant. Estimated cost, $35,000. Noted Dec. 11.

N. Y., Brooklyn—The Bureau of Supplies and Accounts, Navy Dept., Wash., will soon receive bids for furnishing at Navy Yard, here, under Schedule No. 1812, Klinger type, water gage, reflex glasses; under Schedule No. 1808, mechanical thermometers, mercury for thermostats thermometers, 4000 common mercurial thermometers, 2000 water thermometers, 2000 maximum and minimum thermometers and 1000 mercury, storage battery thermometers.

N. Y., Brooklyn—The Bush Terminal Co., 100 Bway., New York City, plans to build an addition to its local transformer station.

N. J., Hoboken—The Remington Arms Co. has awarded the contract for the erection of a 1 story, 81 x 160 ft. factory, to the Austin Co., 16,112 Euclid Ave., Cleveland, Ohio, $40,000. A low pressure boiler for steam heat will be installed by owner.

N. J., Jersey City—The Central Railroad of New Jersey, Communipaw Ave., has had plans prepared for the erection of a local power house. Estimated cost, $50,000. A. E. Owens, New York City, Ch. Engr.

N. J., Newark—The Heller and Merz Co., Hamburg Place, will soon award the contract for the erection of a power house. R. G. Corey, 39 Cortland St., New York City, Archt. Noted May 14.

N. J., Newton—The Sussex Print Works will soon award the contract for the erection of a 50 x 50 ft. addition to its power plant. Estimated cost, $10,000. A. Kidd, Jr., 95 Liberty St., New York City, Arch.

N. J., Woodbridge—Bids will be received until June 3, by the Township Committee for the installation of a heating system in its new municipal building. A. Keyes, Clerk.

Penn., McKeesport—The McKeesport Tinplate Co. plans to install a steam power plant in its mills here. Estimated cost, $1,200,000.

Penn., Philadelphia—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., is receiving bids for the erection of a new power plant at the aircraft factory on League Island.

Wash., D. C.—The Bureau of Supplies and Accounts, Navy Dept., Wash., D. C., will soon receive bids for furnishing at various Navy Yards, under Schedule No. 1806, steam pressure gages.

Va., Norfolk—The Bureau Yards and Docks, Navy Dept., Wash., D. C., is having plans prepared for the installation of an electric lighting and power system in Shipbuilding Slip No. 1. Estimated cost, $15,000.

W. Va., Junior—The Gage Coal and Coke Co. plans to install a 150 kw. 250-275 volt generator in its mine.

S. C., Charleston—The Bureau of Supplies and Accounts, Navy Dept., Wash., will soon receive bids for furnishing at Navy Yard here under Schedule No. 1817, regular, steam and water, seamless drawn, brass pipe; extra strong, steam and water, seamless drawn, brass pipe; regular seamless drawn copper pipe; hard drawn, seamless brass tubing in commercial lengths and hard drawn, seamless copper tubing in commercial lengths.

Ga., Acworth—The Acworth Hosiery Mills is considering plans for the installation of electrically driven knitting machines. Estimated cost, $10,000.

Tenn., Lenoir City—The Public Light and Power Co. of Chattanooga plans to rebuild its electric transmission line from here to Rockwood. W. R. Stern, Winchester, Mgr.

Ohio, Cincinnati—The G. B. 'Curd Co., 602 Merchants Library Bldg., plans to build a 1 story, 40 x 60 ft. boiler shop on Highland Ave.

Ark., Helena—The A. M. Richardson Lumber Co., recently incorporated, is in the market for power plant equipment.

Tex., Brackettsville—The City plans to extend and improve its electric lighting plant.

Tex., Knippa—C. A. Lindsay, 203-4th Natl. Bank Bldg., Wichita, Kan., and associates, are having preliminary surveys made for a hydro electric plant and an irrigation system on the Frio River near here.

Tex., Mercedes—The Mercedes Water, Light and Power Co. is in the market for a new 100 hp. engine and new generator.

Okla., Miami—The Lightfoot Oil and Mining Co. is in the market for engines, boilers, etc., to install in its proposed concentration mill soon to be erected. Total estimated cost, $100,000. W. Lightfoot, Supt.

Okla., Oklahoma—The Chickasaw Hosiery Mill plans to build a large plant. Plans include the installation of 150 hp. steam and electric power plant, etc.

Okla., Prague—The City will soon award the contract for the erection of a 22 mile transmission line south and west of here to connect with the system of the Oklahoma Power and Transmission Co. The work includes the construction of a sub-station and the installation of three 75 kva. 33,000 to 2300 volt, 60 cycle, single phase, transformers, two 500 gpm., 220 ft. lift, direct connected, motor driven, centrifugal pumps, etc. R. Parks, Mayor.

Idaho, Sandpoint—The Falls Creek Mining Co. plans to install a power plant.

Wash., Seattle—The Northwest Trading Co., L. C. Smith Bldg., is in the market for electric lighting and power plant equipment including a turbine generating set directly connected, a three-phase, 6600 volts, 5 cycles, electrical system, etc.

Wash., Waterville—The Chelan Falls Power Co. has petitioned the Douglas County Commissioners for authority to build a transmission line here.

Ore., Astoria—The Hammond Lumber Co. plans to install additional electric power equipment including a turbine and generator and four 600 hp. water tube boilers.

Ore., Portland—The Pacific Power and Light Co. plans to build a 660 volt, 3 phase transmission line from here to the plant of the Utah Idaho Sugar Co. I. C. Martin, Engr.

Ore., Reedsport—The Umpqua Light and Power Co. is having preliminary plans prepared for the erection of a transmission line over the Umpqua River.

Calif., Bolinas—The Chetco Mining Co. plans to install electrically driven pumping equipment in its plant here.

N. S., New Watford—The Dominion Coal Co., Sydney, plans extensive power developments including the erection of a central power station here.

Que., Grand Mere—The Laurentide Power Co. plans to install 3 additional units, 20,000 hp. each. J. Ruddick, Beaupre, Engr.

Ont., Sault Ste. Marie—The Great Lakes Power Co. plans to rebuild its power plant which was recently destroyed by fire. A. E. Pickering, Mgr.

Ont., Thedford—The Town plans to install a lighting and power system. W. Brookes, Clerk.

Sask., Regina—The City is in the market for a 5000 kw. electric unit. Estimated cost between $175,000 an $200,000. G. Beach, Clerk.

B. C., Revelstoke—The Lanark Mines Co. plans to build a power plant and install equipment in same. W. B. Dornberg, Spokane, Wash., Mgr.

H. T., Pearl Harbor—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., is having plans prepared for additions and improvements to the power plant here. Estimated cost, $150,000.

CONTRACTS AWARDED

Ohio, Cleveland—The Illuminating Co., Illuminating Bldg., has awarded the contract for the erection of a 1-story, 35 x 168 ft. addition to its power house on East 70th St., to the National Concrete and Fireproof Co., 1315 Citizens Bldg., $60,000. The owner is in the market for electric equipment, switch boards, etc.

Ohio, Columbus—The Board of Education has awarded the contract for a heating and lighting system in the shop school wing to the Huffman-Conklin Plumbing Co., 669 North High St., Erie, Penn. Estimated cost, $27,500.

Okla., Miami—The Mint Mining Co. is building a concentration plant. Estimated cost, $100,000. Work includes the installation of boilers, engines, etc. J. Labsap, Supt.

THE COAL MARKET

Boston—Current quotations per gross ton delivered alongside Boston points as compared with a year ago are as follows:

ANTHRACITE

	Circular Current	Individual Current
Buckwheat	$4.60	$7.10—7.35
Rice	4.10	6.65—6.90
Boiler	3.90	.....
Barley	3.60	6.15—6.40

BITUMINOUS

Bituminous not on market.

Pocohontas and New River, f.o.b. Hampton Roads, is $4, as compared with $2.85—2.00 a year ago.

*All-rail to Boston is $2.60. †Water coal.

New York—Current quotations per gross ton f.o b. Tidewater at the lower ports* are as follows:

ANTHRACITE

	Circular Current	Individual Current
Pea	$4.90	$5.65
Buckwheat	4.45@5.15	4.80@5.50
Barley	3.40@3.65	3.80@4.50
Rice	3.90@4.10	3.00@4.00
Boiler	3.65@3.90	.....

Quotations at the upper ports are about 5c. higher.

BITUMINOUS

	F.o.b. N. Y. Gross	Mine Price Net	Gross
Central Pennsylvania	$5.06	$3.05	$3.41
Maryland—			
Mine-run	4.84	2.85	3.19
Prepared	5.06	5.05	3.41
Screenings	4.50	2.55	2.85

*The lower ports are: Elizabethport, Port Johnson, Port Reading, Perth Amboy and South Amboy. The upper ports are: Port Liberty, Hoboken, Weehawken, Edgewater or Cliffside and Guttenberg. St. George is in between and sometimes a special boat rate is made. Some bituminous is shipped from Port Liberty. The ratte to the upper ports is 5c. higher than to the lower ports.

Philadelphia—Prices per gross ton f.o.b. cars at mines for line shipment and f.o.b. Port Richmond for tide shipment are as follows:

	Line		Tide	
	Current	One Yr. Ago	Current	One Yr. Ago
Pea	$3.45	$3.00	$4.35	$3.90
Barley	2.15	1.50	2.40	1.75
Buckwheat	3.15	2.50	3.75	3.40
Rice	2.65	2.00	3.65	3.00
Boiler	2.45	1.80	3.55	2.90

Chicago—Steam coal prices f.o.b. mines:

Illinois Coals	Southern Illinois	Northern Illinois
Prepared sizes	$2.65—2.80	$3.35—3.50
Mine-run	2.40—2.55	3.10—3.25
Screenings	2.15—2.30	2.85—3.00

Smokeless Coals	So. Ill., Pocohontas, Pennsylvania and W. Va.	Hocking, East Kentucky and West Va. Splint
Prepared sizes	$2.60—2.85	$2.85—3.35
Mine-run	2.40—2.60	2.60—3.00
Screenings	2.10—2.55	2.35—2.75

St. Louis—Prices per net ton f.o.b. mines are as follows:

	Williamson and Franklin Counties	Mt. Olive & Staunton	Standard
6-in. lump	$2.65-3.00	$2.65-2.80	$2.65-2.80
2-in. lump	2.65-3.00	2.65-2.80	2.25-2.50
Steam egg	2.65-2.80	2.35-2.50	2.25-2.40
Mine-run	2.45-2.60	2.45-2.60	2.45-2.60
No. 1 nut	2.65-3.00	2.65-2.80	2.65-2.80
2-in. screen	2.15-2.40	2.15-2.40	2.15-2.40
No. 5 washed	2.15-2.50	2.15-2.35	2.15-2.35

Birmingham—Current prices per net ton f.o.b. mines are as follows:

	Mine-Run	Lump & Nut	Slack and Screenings
Big Seam	$1.90	$2.15	$1.65
Pratt, Jagger, Corona	2.15	2.40	1.90
Black Creek, Cahaba	2.40	2.65	2.15

Government figures.

Individual prices are the company circulars at which coal is sold to regular customers irrespective of market conditions Circular prices are generally the same at the same periods of the year and are fixed according to a regular schedule.